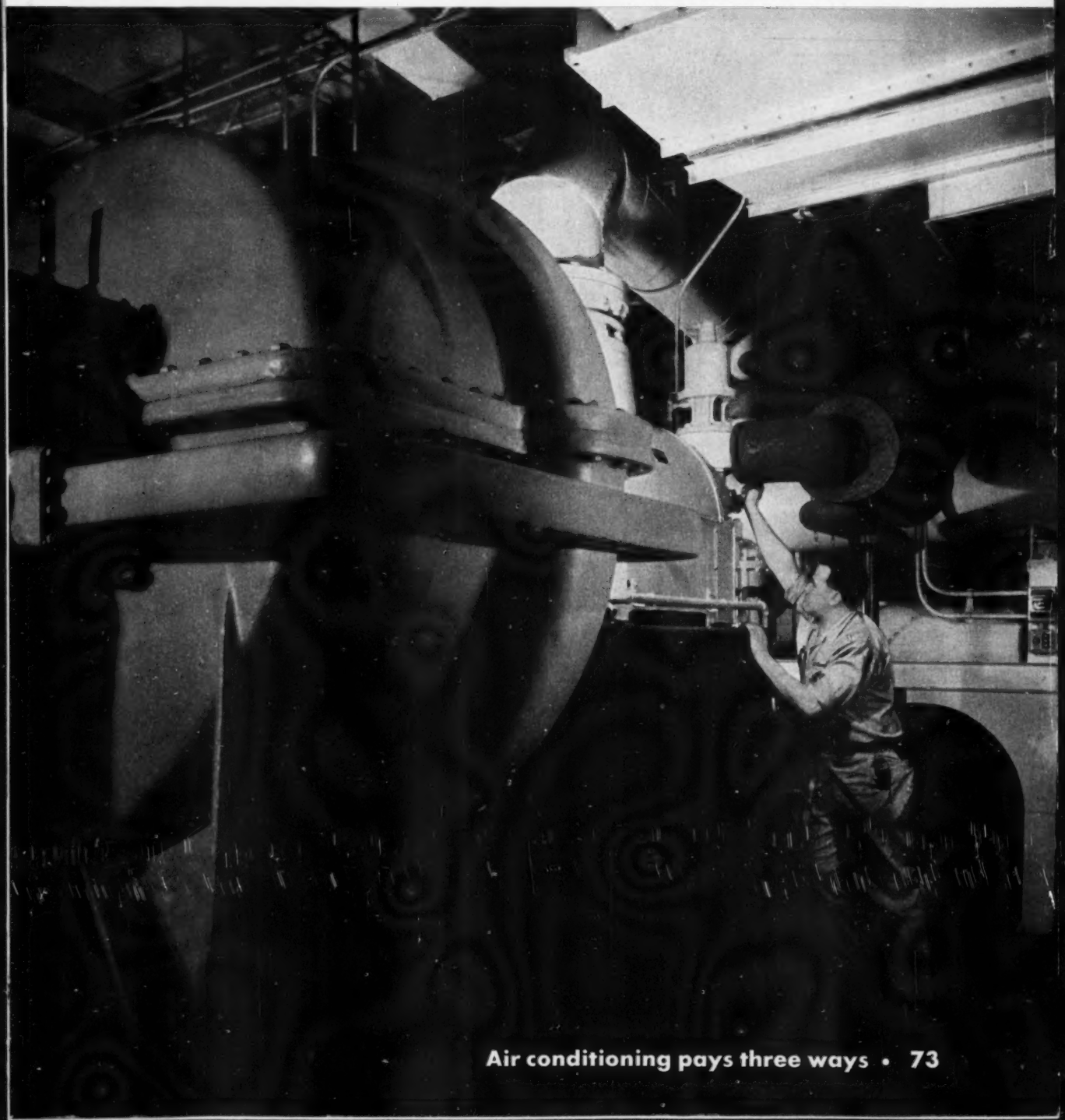
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

In this issue
COMPRESSING AIR
a 20-page handbook

Power

June
1953·50¢

A McGRAW-HILL PUBLICATION

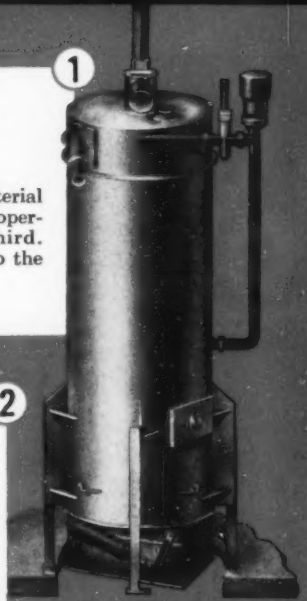


Air conditioning pays three ways • 73

How much can these new DUST-handling developments save your plant?

1 Continuous Vacuum Collector

Collects and dumps material simultaneously, cutting operating time by one-third. Carry-over is reduced to the vanishing point.



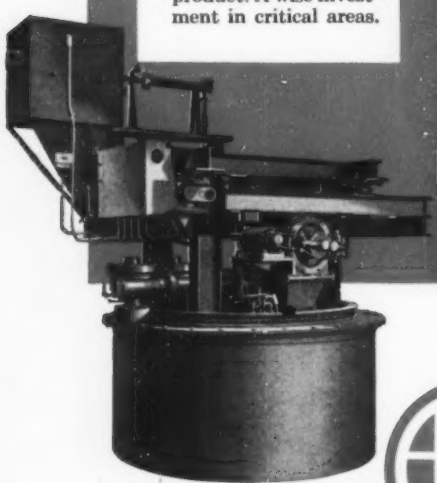
2 Batch Type Dust Conditioner

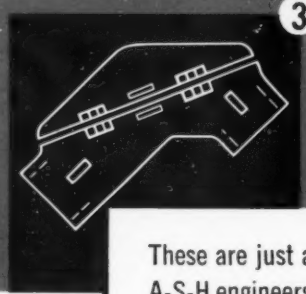
Eliminates dust nuisance during unloading. Automatic operation insures uniform results and ideal end product. A wise investment in critical areas.

4 Automatic Sequence Head

All system components are controlled by a single master switch. By assuring maximum loading of the transporting air, it gives top efficiency and minimum wear.

You can count on A-S-H to pioneer in modern disposal methods





3 Impact Fittings with Removable Wearbacks

A complete line of fittings, designed with all joints machined in a single plane. Plastic filler is not needed, and joints maintain their tightness. Wearbacks are interchangeable and are reversible for double life.

These are just a few of the many new components that A-S-H engineers have developed to reduce disposal costs while making cleaner plants. Let these men help you streamline your present system or design a new one for you from scratch. Send today for Catalogs 652 and 752.

A-S-H

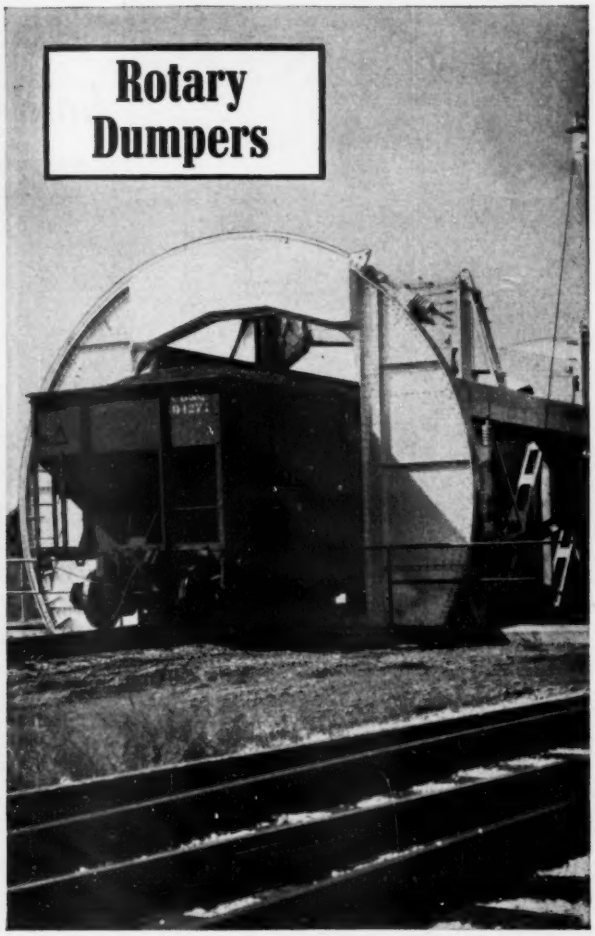
THE ALLEN-SHERMAN-HOFF CO. Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.

Offices and Representatives in Principal Cities

HYDROJET (hydraulic) HYDROVAC (pneumatic)

materials handling systems

EASIER ON CARS with minimum noise level . . . thanks to exclusive low-frequency vibration. The Link-Belt Car Shaker helps hopper cars empty themselves. Even hard-packed loads come "broom clean" in a matter of minutes. Especially good for damp, sticky materials. Write for Book 2345.



BOTTOMS UP . . . empties 90-ton car every 60 seconds or less (including return to upright position) by simply turning car upside down. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

Railroad cars come clean . . . in as little as 60 seconds or less!

For fast, safe, push-button car unloading . . . at substantial savings — choose Link-Belt equipment

IF you empty a few gondola cars a day—or several thousand a week, Link-Belt makes the right railroad car unloader for your particular requirements. Only Link-Belt builds both types—the automatic Rotary Car Dumper for large users . . . the low-frequency Car Shaker for smaller operations.

Both are precision engineered to reduce unloading hazards, minimize injury possibilities, cut costly demurrage charges.

Yes, if your operations require rapid railroad car unloading of any bulk material, it will pay you to call your nearest Link-Belt representative. He'll give you an unbiased recommendation for the right type of equipment for your needs.

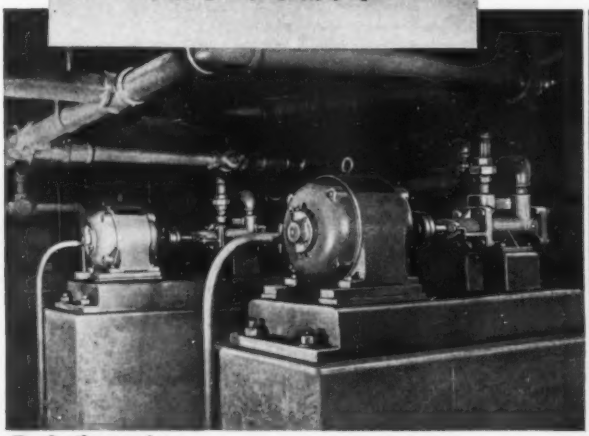
LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

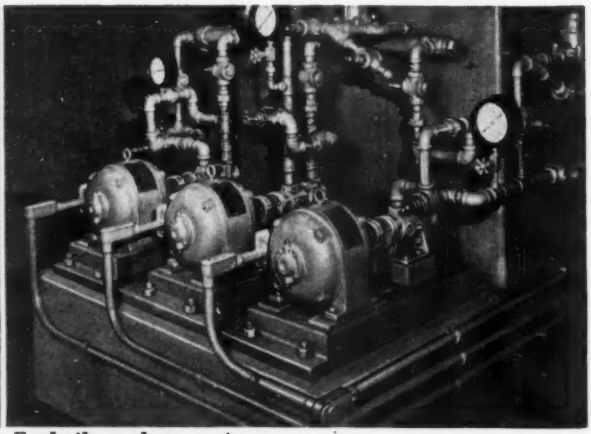
LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,203

DE LAVAL
IMO PUMPS

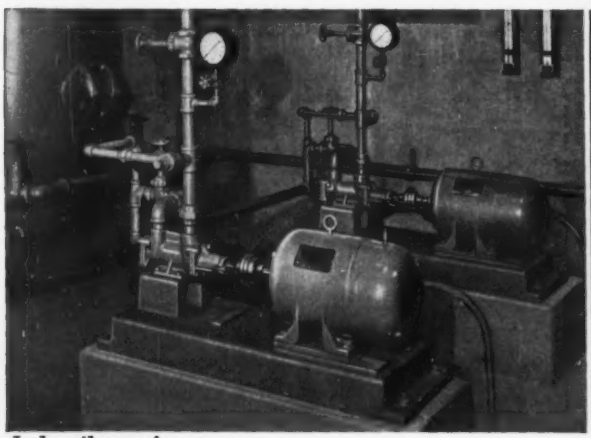
hold down 4 jobs at Owl's Head



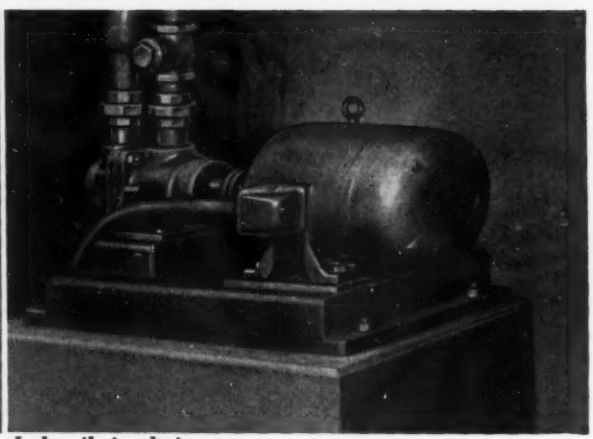
Fuel oil transfer



Fuel oil supply to engines



Lube oil transfer



Lube oil circulating

Again De Laval IMO rotary pumps prove their versatility. Eighteen of them are handling all the fuel and lube oil services for the six National Supply Company dual-fuel engines in the new Owl's Head sewage treatment plant in Brooklyn, New York.

The unique IMO design—*with only three moving parts*—assures long, trouble-free performance. IMO pumps are quiet, pulsation-free, compact and excellent for direct-connected high-speed operation.

Whether your power source is dual-fuel, gas or diesel engine, or oil-fired steam, be sure to specify IMO pumps for your next oil handling job. Use them in high and low pressure fuel oil burner sets, pumping fuel oil to burners, unloading and transferring fuel and diesel oil, handling oil for lighting off service and providing pressure lubrication on pumps and turbines. Send for Bulletin LG showing complete IMO line for capacities to 1,000 gpm at pressures to 500 psi and for capacities to 150 gpm at pressures to 1,500 psi.

DE LAVAL *IMO Pumps*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

DL 187

Power

JUNE 1953 • VOLUME 97 NUMBER 6

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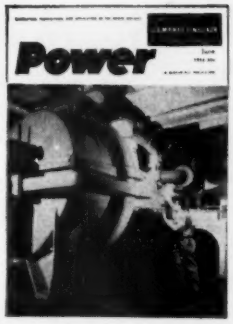


AIR CONDITIONING, once a novelty, has become just about standard equipment for modern office buildings. Typical of these installations is the 1290-ton plant at 260 Madison Ave, N.Y.C., pictured on our cover. Taken in full color by Syd Karson of McGraw-Hill photographic staff, the photo shows this fine layout to advantage.

In industry, air conditioning has also become standard for specialized process applications, but its value on a plant-wide basis is still subject to debate. For one side of this discussion, turn to pp 73-75, where the president of Rotor Tool Co tells what complete air conditioning did for his metal-working plant. He makes a mighty good case for it, citing dividends in production, quality and employe morale.

Next month . . .

■ Unless expected release is delayed, July will bring you a special report on nuclear power. It will summarize studies made by four industry teams—including plant layouts and estimated costs. So you may easily grasp these history-making proposals for commercial power from the atom, we're including an exclusive review of the fundamentals of nuclear fission.

■ Next Operator's Notebook will deal with centrifuges for fuel and lube-oil purification—how to use them, how to keep them in top operating shape.

■ A unique picture story in July will take you, step by step, through a big power-plant insulating job. It will show how modern materials are applied by modern methods to boilers, turbines, ducts, piping, auxiliary equipment.

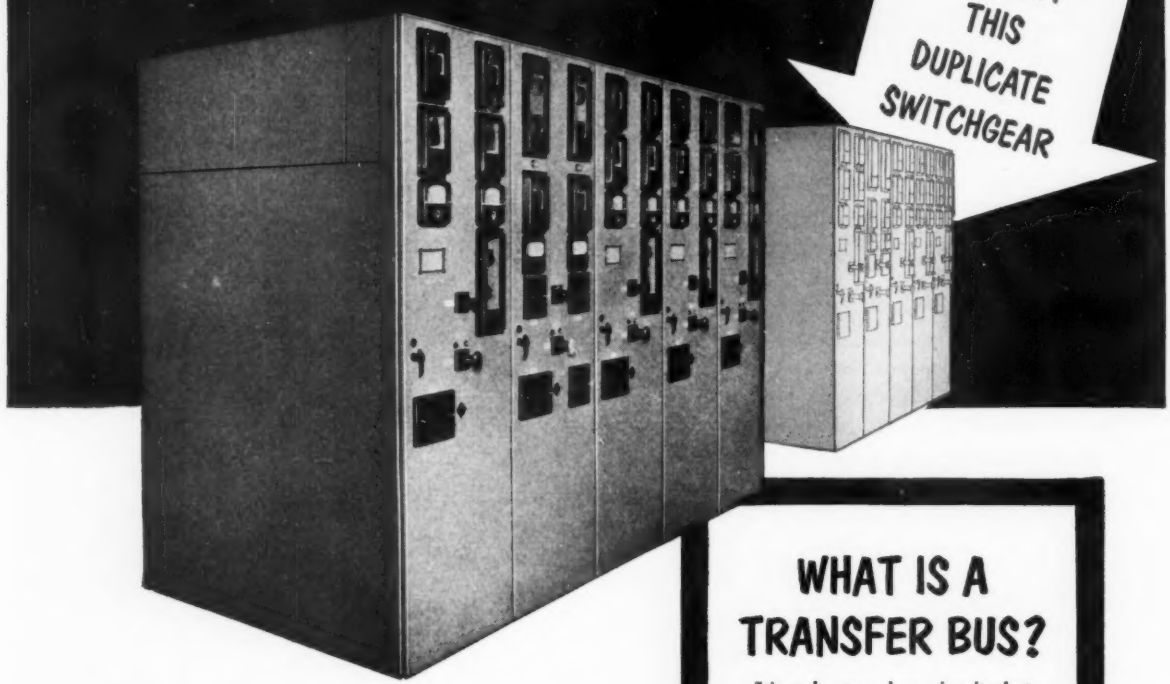
■ Variable-displacement pumps get the call where flow must be controlled within close limits. Upcoming article tells how typical designs operate, how to apply them, what they can do.

. . . and future months

Associate Editor Jim O'Connor has just completed a two-month tour of leading makers of electrical equipment, top consultants and big users. Primed with the latest dope, he's starting to produce what promises to be an outstanding report. More about it later!

ALLIS-CHALMERS

METAL-CLAD Switchgear ..With Transfer Bus Assures Power Continuity



WHAT IS A TRANSFER BUS?

It's a by-pass bus circuit that parallels the main switchgear bus . . . with means provided for switching loads to the transfer bus. Also makes it possible to withdraw and maintain circuit breakers, or inspect main bus without power outage. This method proved by utilities in hundreds of installations.

Saves 1/3 the Cost

You pay only for the addition of the transfer bus . . . not a complete set of duplicate switchgear with all of its expensive components. At least one-third is saved on entire installation.

Saves 1/2 the Space

Allis-Chalmers supplies transfer bus in same cubicle as switchgear, without adding cubicles . . . thus cutting floor space one-half.

Ask an Allis-Chalmers engineer about transfer bus arrangements and what they can mean to your plant in savings and service. And learn too about the unusual features that make it so easy to install A-C switchgear. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3773

ALLIS-CHALMERS

Power

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...lines and bylines

William Godley

TOUGH JOBS, the ones that other engineers sidestep, are meat to Bill Godley. Take a look at the story beginning on p 114 to see what we mean about tackling the tough ones.

Bill acquired an ME at Stevens Institute of Technology in 1918, just in time to do his bit in World War I as an ensign. When World War II rolled around, Bill had to be content with a Stateside job. By then he had been with Peabody Engineering Corp for many years, had absorbed a vast amount of know-how on all phases of burning oil. It was thus only natural that the Maritime Commission should grab him to design oil-burning systems. Later, along with many other industry specialists, Bill served a term with National Production Authority (NPA).

When he's not making tough engineering jobs look easy, Bill commutes to Port Washington, enjoys swimming and sailing with his family on Long Island's many-harbored north shore.

Tharon J Ellis

BULLET-SEALING gas tanks for military aircraft seem a far cry from maintenance systems, but Tharon Ellis has developed both. His 30 years in the rubber industry have been marked by accomplishment in both product development and administration.

Following service with Firestone Tire & Rubber Co as plant manager, he took part in design and production of life-saving self-sealing tanks, gas masks, bullet-proof vests.

With an enviable 20-yr record behind him at Firestone, he joined Thermoid in 1949. Last year he was elected vice-president in charge of manufacturing. One of his chief interests has been in ways of keeping on top of the many maintenance jobs in a large industrial plant. Some of his thinking on this angle appears in the article on p 109.

Your bonus

POWER'S special mid-September

MODERN PLANT HANDBOOK ISSUE

1. *Modern Plant Survey:* Tabulated technical data on more than 500 new generating plants—steam and hydro—utility and industrial.

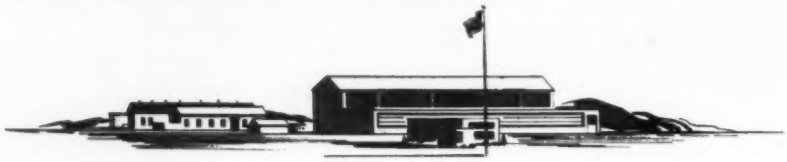
2. *Renovation Roundup:* Things to remember when you tackle the big job of modernizing your plant—practical tips on steam, electricity, heating, air conditioning, refrigeration, compressed air and water services.

3. *Directory of Manufacturers:* A complete powerfield index of products and materials useful in plant modernization. More than 600 listings.

4. *Cross File of Obsolescence:* Names of former makers of power equipment, matched with present name of successor company. Handy when seeking replacement parts for old equipment.

5. *Review of New Products:* Those that have been described, month by month, during the year.

From B&W Research & Engineering . . .



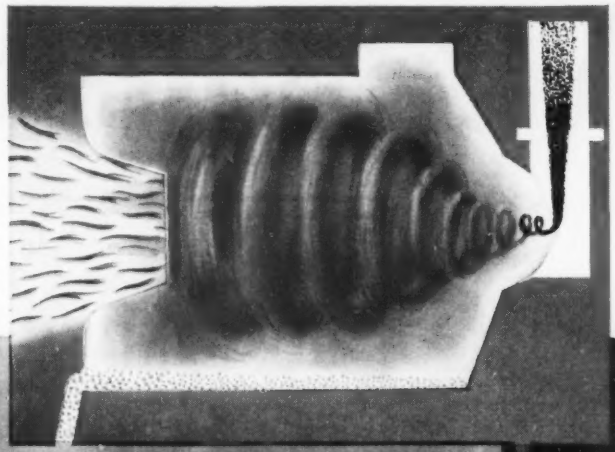
important advances in firing

Two important advances in firing—the Cyclone Furnace and Pressure Firing—used singly or in combination, are bringing major savings to central station and industrial boiler users. The reception and wide acceptance given both of these B&W developments result from proved efficiency and economy . . . amply demonstrated in the chart below.

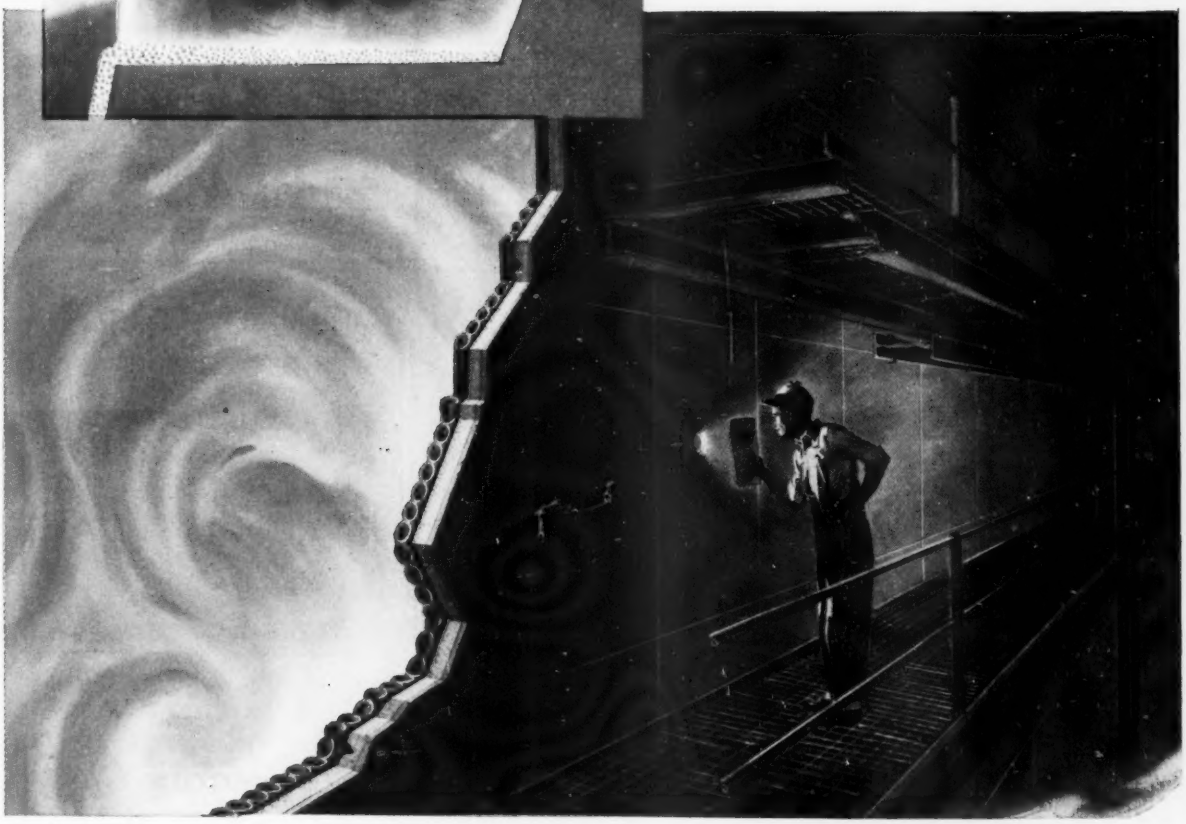
The chart lists many possible ways in which the Cyclone Furnace and Pressure Firing contribute to better operation—often just one advantage means important economy. The revolutionary Cyclone Furnace and B&W's long-range experience with Pressure Firing are well worth serious consideration in your evaluation.

We will be pleased to discuss these and other practical developments of B&W Research and Engineering as they relate to your power generation program and facilities. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

	EFFICIENCY	MAINTENANCE	AVAILABILITY	AUXILIARY POWER
CYCLONE FURNACE	• Efficient use of low-grade coals. • Extremely low carbon loss. • Low excess air.	• Practically no ID fan erosion. • Eliminates pulverizer maintenance. • Low maintenance on burner and coal preparation equipment. • Reduces cost of labor for ash and dust handling.	• Reduces slagging and cleaning of convection surfaces.	• Eliminates pulverizers. • Less soot blowing required.
PRESSURE FIRING	• Less stack loss . . . no air infiltration.	• Fewer controls to maintain. • No ID fan maintenance.	• Simplifies fan control.	• Less total fan power due to lower volume, weight, and draft loss handled by FD fan.



CYCLONE FURNACE



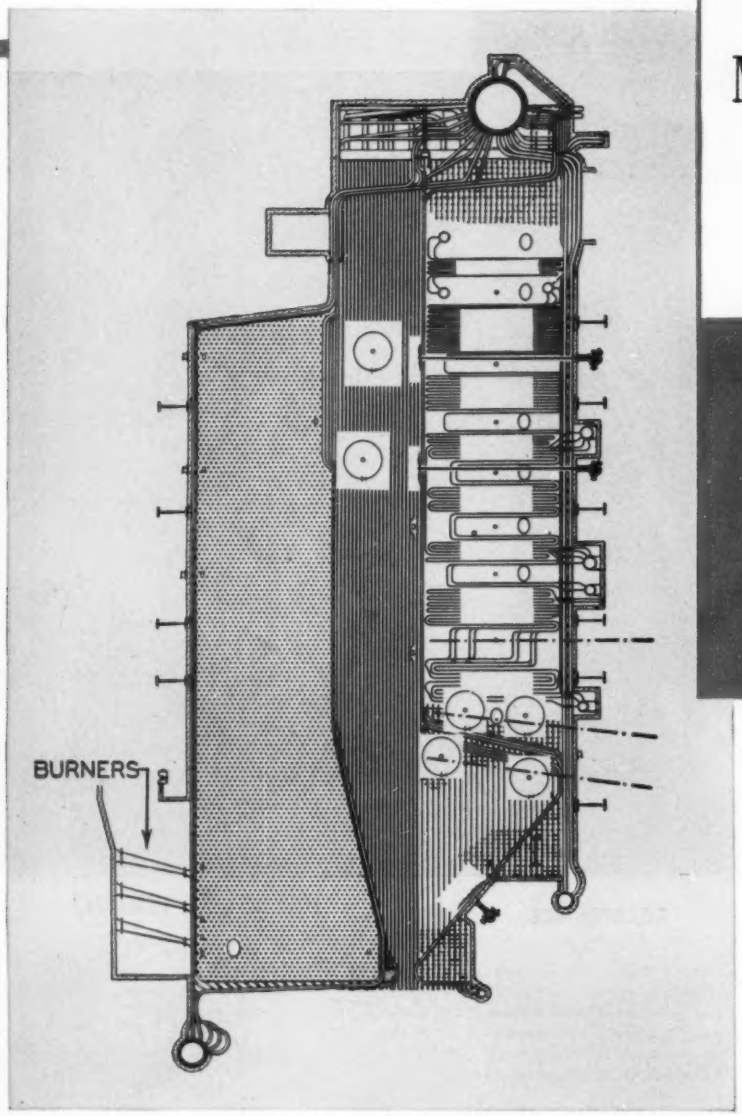
PRESSURE FIRING

INITIAL COST	ACCEPTANCE
• Lower building and foundation costs. • Greatly reduced fly ash emission requires less dust handling equipment . . . smaller precipitators • Eliminates electrical connections and controls for PC motors • Smaller soot blower compressor.	B&W's revolutionary method of firing is being used for boilers having steam capacities as high as 1,200,000 lb per hr., pressures to 2250 psi, and temperatures to 1050 F. Burning coal, oil, and gas. Total generating capacity of all Cyclone Furnace Boilers in service and on order is over 2,000,000 KW. Accumulated service-time on all units is nearly a half century.
• Simplified design lowers duct and stack costs • ID fan can often be eliminated.	Broad acceptance of B&W's pressurized-furnace design is shown by the units in service and on order—by 27 electric utilities and some industrial plants—to serve a total generating capacity exceeding 8,500,000 KW. They include Radiant, Open Pass, Integral-Furnace and Stirling Boilers with individual steam capacities ranging between 200,000 and 1,370,000 lb per hr., design pressures to 2700 psi, and temperatures to 1100 F.

BABCOCK & WILCOX

G-596

DIAMOND Boiler



For MUSKINGUM RIVER PLANT

The Ohio Power Company

American Gas and Electric System

2 UNITS

50th ANNIVERSARY 1903-1953

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited • *Windsor, Ontario*

6262

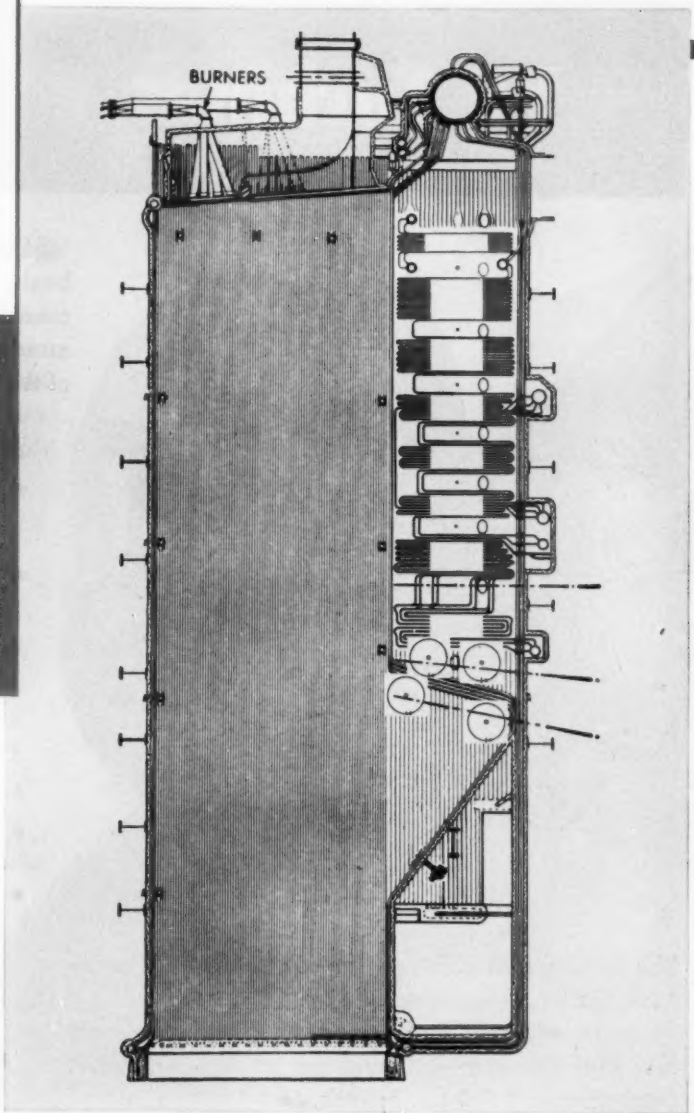
Cleaning Systems

For KANAWHA RIVER PLANT

Appalachian Electric Power Company

American Gas and Electric System

2 UNITS



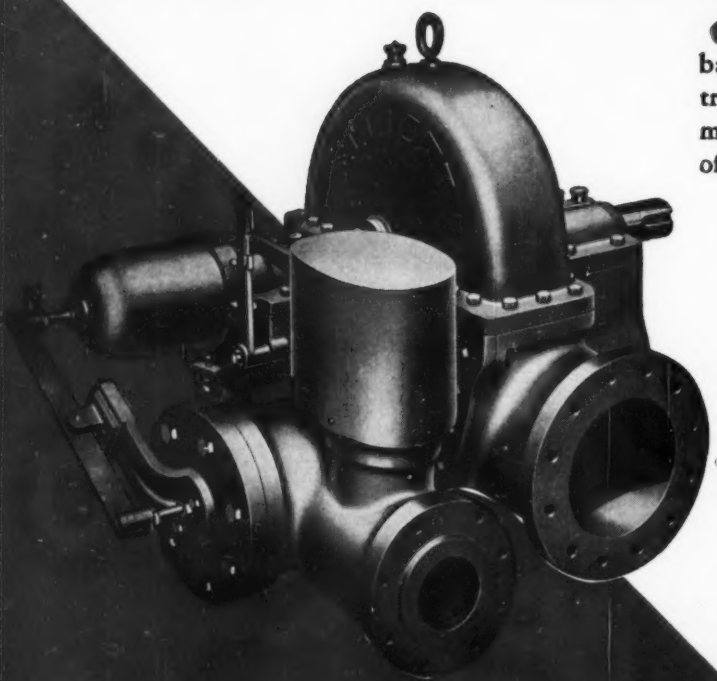
Similar, yet different, these units are built in the tradition of American Gas & Electric philosophy: "for tomorrow." Incorporating high pressure . . . high temperature . . . reheat . . . pressure firing . . . flue gas recirculation, they will provide economical power to serve the growing capacity needs in two different areas.

Both plants will have Diamond retractable type blowers (throughout) to assure safe, economical and reliable operation. These units are constructed along principles successfully established at Twin Branch, Tanners Creek and Philip Sporn Plants which are all Diamond equipped *throughout*.

Both strong in

YR Turbines

ELLI



●YR Turbines are built on a production basis, but engineered to allow an extremely wide range of modifications to meet specific conditions. Here are some of them:

- **Five frame sizes —**
- **Eight different turbine types —**
- **Your choice of several governors each independent of the standard overspeed governor —**
- **Six elective control devices, including:**

1. Two hand valves controlling nozzling
2. Hand-operated speed changer
3. Remote control speed changer, air or electric
4. High exhaust pressure trip
5. Remote control electrical trip
6. Hand throttled emergency trip valve.

- **Gland seal piping for condensing operation, or operation with gas —**
- **Exhaust connection on either side.**

This turbine makes friends everywhere, in all industries, for its fullest-made adaptability, its simplicity, its extremely reliable performance, its surprisingly low maintenance—all qualities of highest value. Capacities to 2500 hp. Speeds 800–7000 rpm.

ELLIOTT

STEAM TURBINE DEPT. • JEANNETTE, PA.

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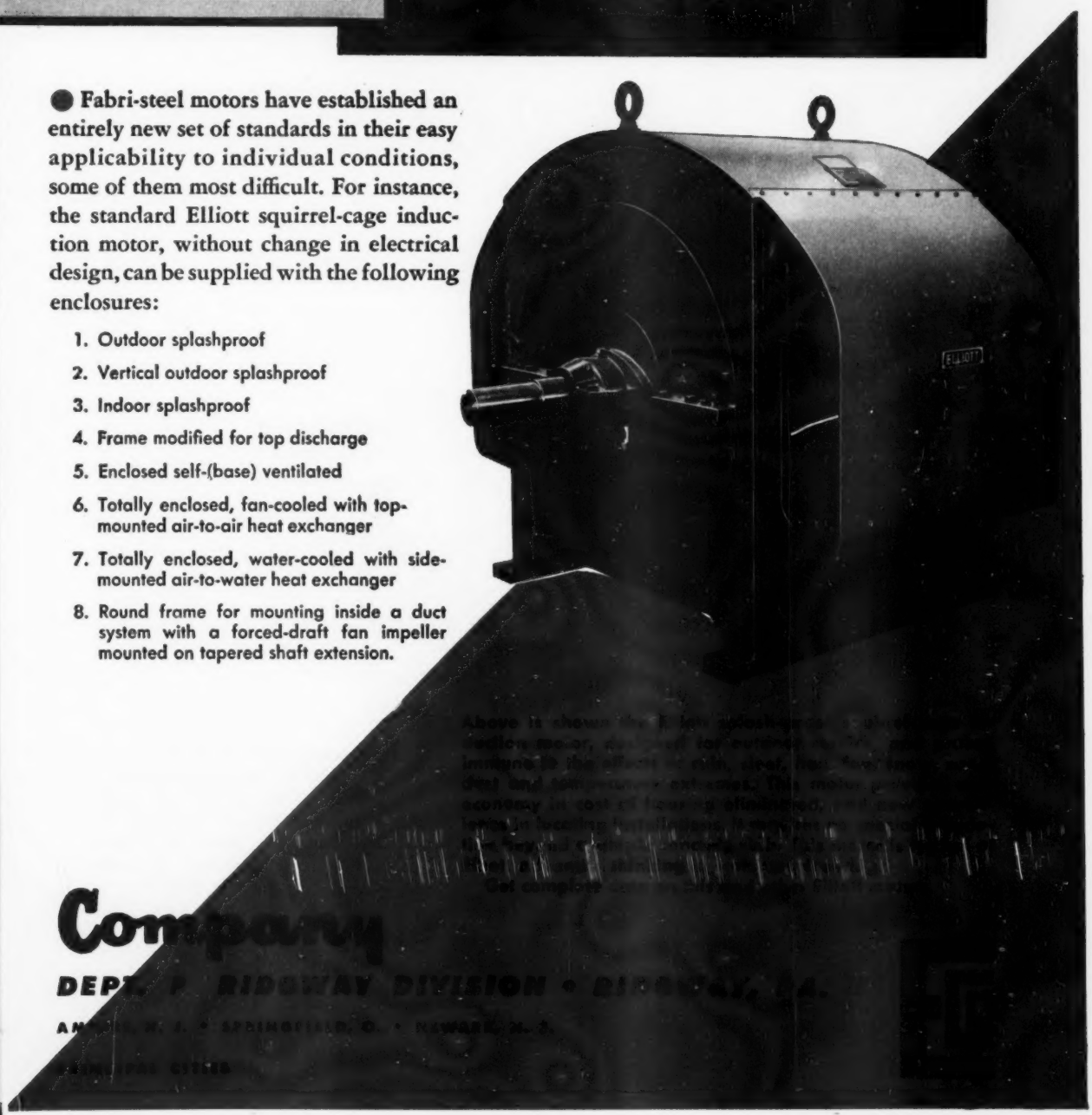
DISTRICT OFFICES:

adaptability!

OTT Motors

● **Fabri-steel motors have established an entirely new set of standards in their easy applicability to individual conditions, some of them most difficult. For instance, the standard Elliott squirrel-cage induction motor, without change in electrical design, can be supplied with the following enclosures:**

1. Outdoor splashproof
2. Vertical outdoor splashproof
3. Indoor splashproof
4. Frame modified for top discharge
5. Enclosed self-(base) ventilated
6. Totally enclosed, fan-cooled with top-mounted air-to-air heat exchanger
7. Totally enclosed, water-cooled with side-mounted air-to-water heat exchanger
8. Round frame for mounting inside a duct system with a forced-draft fan impeller mounted on tapered shaft extension.



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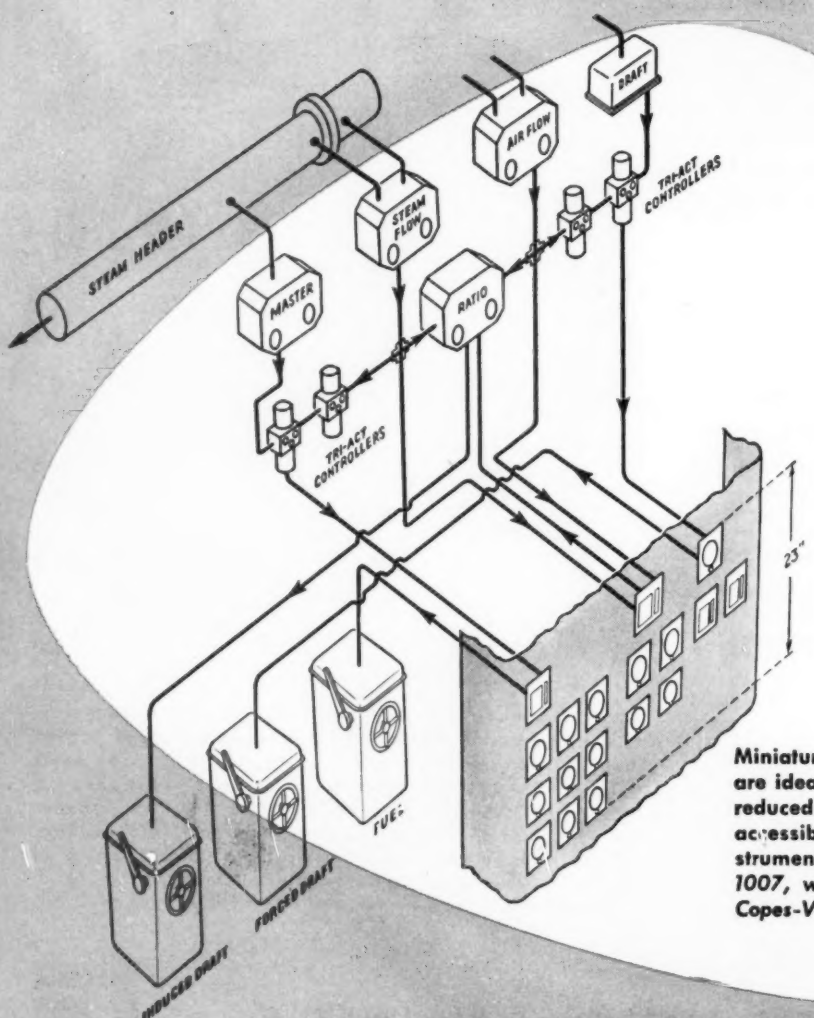


Miniature instruments as shown are ideal for graphic, console or reduced size panels. All parts accessible without removing instrument case. *Write for Bulletin 1007, which describes complete Copes-Vulcan Boiler Control.*

=BBC

= BETTER BOILER CONTROL

WHAT'S IN A NAME?

COPES has for half a century specialized in the control of boiler feed water flow and pressure, boiler water level—and, more recently, boiler steam temperature.

VULCAN has since 1903 brought soot blowing from an act of drudgery to the ease and convenience of merely pushing a button at a centrally located control panel.

Taylor has for over 100 years led in instruments for measuring and controlling temperature, pressure, flow and liquid level in the process and power fields.

Focus this broad new thinking on your boiler control problem. Combining the skills of three recognized leaders in power and process controls, it will mean Better Boiler Control, including:

Combustion Control from steam flow—air flow, or by fuel-air ratio. *Feed Water Control* from three, two or one influences—mechanical or instrument type. *Steam Temperature Control* from three or two influences, through burner or damper positioning, gas recirculating, direct cooling-water spray or heat exchanger. *Soot Blower Control* by fully-automatic sequence or from individual push button stations.

Standard or miniature instruments by Taylor permit any panel arrangement—conventional, console or graphic.

And Copes-Vulcan assumes undivided responsibility for service whenever or wherever needed—throughout the life of the installation.

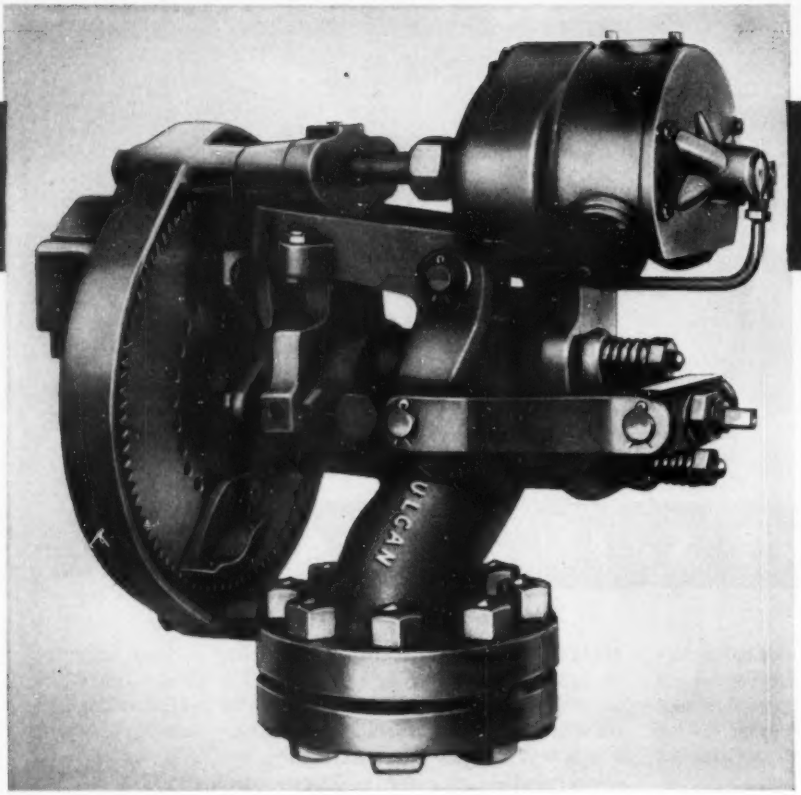
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

COPES VULCAN

BOILER CONTROL

WITH INSTRUMENTATION

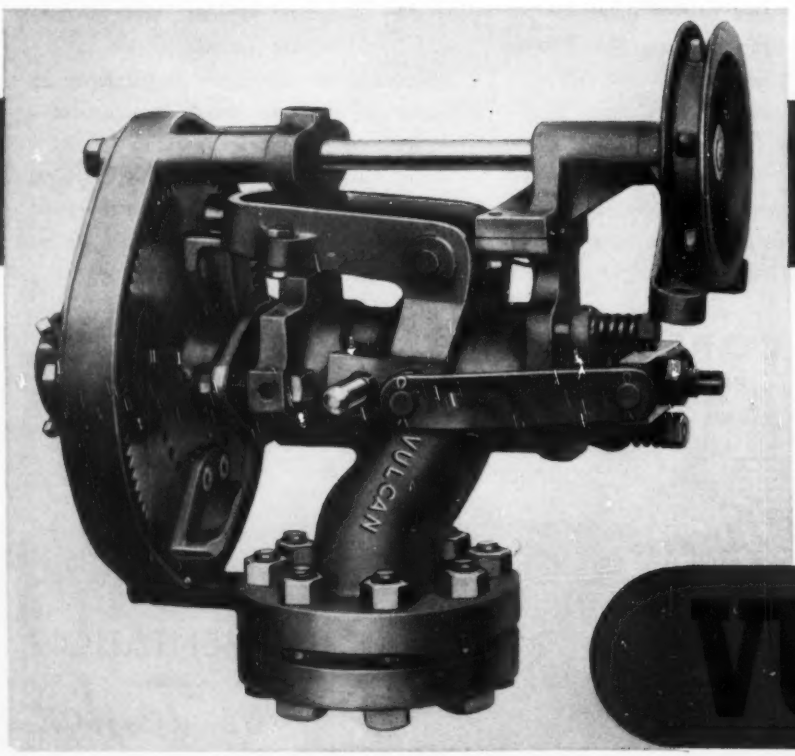
BY *Taylor*



Proved

VULcomatic E-4 air-operated rotary head for automatic soot blowing. E-4-E has electric motor drive. Either may be cut into service by push button—or operated in automatic sequence. Cleans effectively. Easily installed and maintained.

Write for Bulletin 1006-A.



Tops

Hand-operated Vulcan P-3 is identical with the VULcomatic E-4 except for drive. In fact, it is quickly converted to an automatic unit by replacing the sheave wheel with an air or electric motor.

Write for Bulletin 1005-A.

VULCAN

on big BOILERS

YOU'LL FIND Vulcan Rotary Soot Blowers doing a thorough cleaning job on many high-duty central station and industrial boilers. Their full-pressure cleaning starts at the crack of a valve, and continues through a complete 360-degree arc. Their valves are protected, for corrosive gases are sealed off. Their installation may be at any angle. And all their parts are easily accessible for inspection or maintenance.

You'll also find Vulcan Rotaries—proved on big boilers—are "tops" for small. Whatever your boiler size or pressure—or your method of firing—depend on Vulcan for thorough cleaning and low-cost maintenance.

for small BOILERS

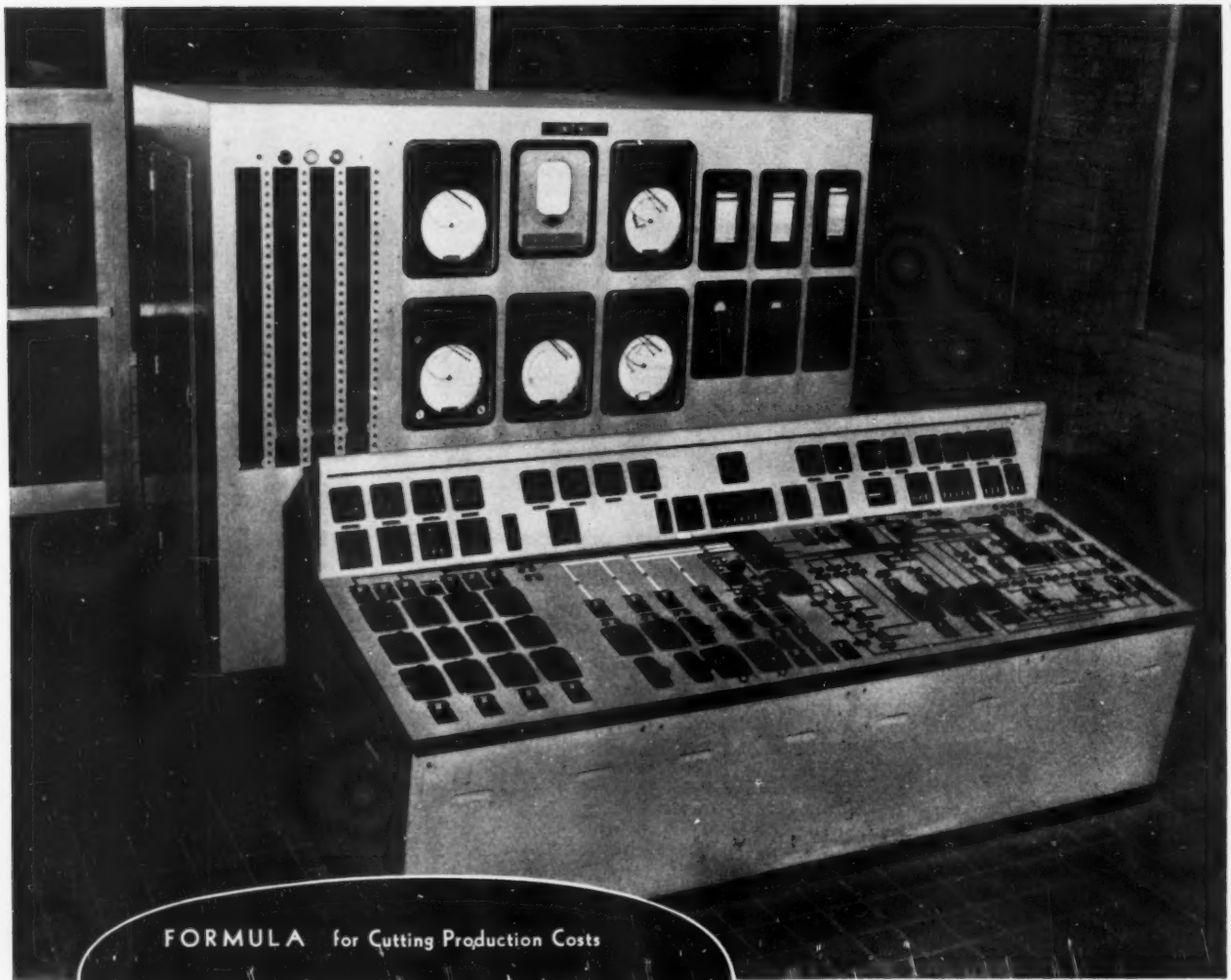
COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE, PENNSYLVANIA

Rotary SOOT BLOWERS

How to Increase the Return on



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Center for 60,000 kw reheat boiler-turbine Unit No. 1 at Danskammer Point Steam Station of Central Hudson Gas & Electric Corp. Bailey MINI-LINE Equipment on benchboard gives operators fingertip control while larger recorders on vertical board show operating trends and make permanent records. Duplicate Bailey Equipment has been purchased for Unit No. 2.

Engineering and construction by Burns and Roe, Inc.

Your Boiler Room Investment

★ There are four important ways to increase the return on your Boiler Room Investment:

More power per fuel dollar
Less outage
Delivery of steam at design conditions
Greater operating safety

None of these items taken alone will produce the highest return—it takes all four working in close harmony.

That's where co-ordinated controls by Bailey Meter Company help. And here is why Bailey Controls are your best choice:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

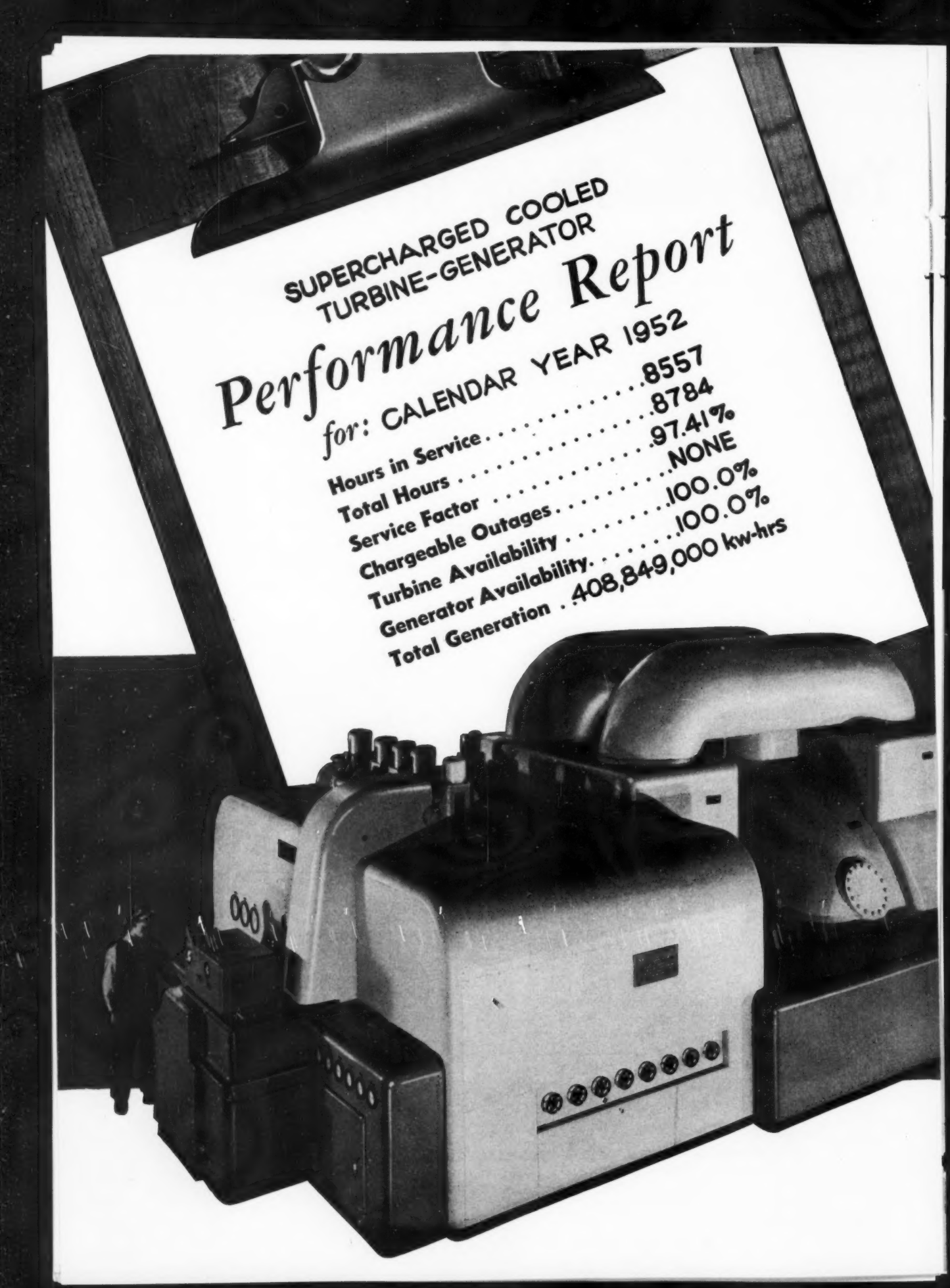
3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's Sales-Service Engineers are located in more Industrial Centers than those of any other manufacturer of Boiler Control Systems; you get prompt, experienced service with a minimum of travel-time and expense.

For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage, steam at design conditions, and greater operating safety—you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-115-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS


SUPERCHARGED COOLED
TURBINE-GENERATOR
Performance Report
for: CALENDAR YEAR 1952
Hours in Service 8557
Total Hours 8784
Service Factor 97.41%
Chargeable Outages . . . . . NONE
Turbine Availability 100.0%
Generator Availability 100.0%
Total Generation . . 408,849,000 kw-hrs

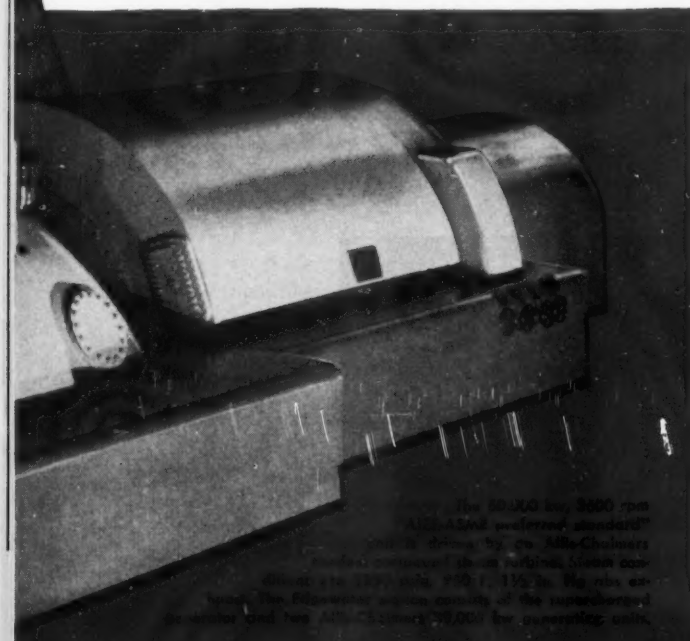
Availability for Duty: 100.0%!

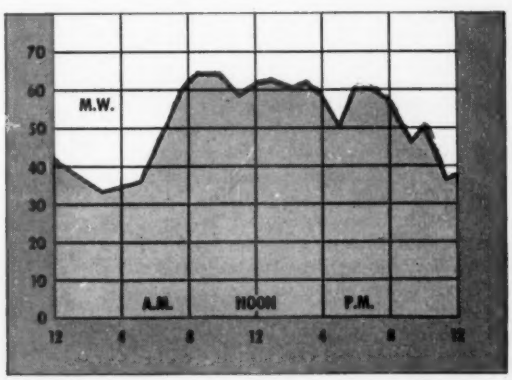
Supercharged Hydrogen Cooling — the greatest advance *ever* made in turbine generator design — has proved itself brilliantly in its first full year's commercial operation!

At left is the calendar year 1952 Performance Report on the Allis-Chalmers 60,000 kw steam turbine generator unit at the Edgewater station, Sheboygan, Wisconsin Power and Light Company. Both turbine and generator Availability were 100.0%, with on-the-line Service Factor over the entire year being 97.41%.

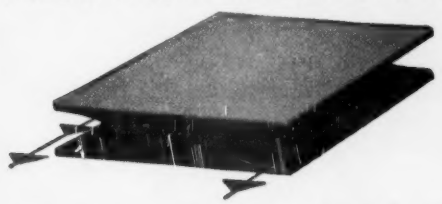
Cooling by driving hydrogen at high velocity directly *through* the conductors — supercharging — was first developed and applied by Allis-Chalmers. Supercharging has already permitted increase in generator rating of more than 70% over ordinary hydrogen cooling, with even greater gains forthcoming.

You get the real design advances *first* from Allis-Chalmers, builder of the world's widest range of power plant equipment. When planning a steam-electric power plant, your task will be simpler and results better if you deal with Allis-Chalmers. For complete literature on all products, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3981





Typical daily load cycle of the Sheboygan supercharged unit. It experiences wide load fluctuations because it operates in parallel with base load hydro power. Supercharged units are suited for even this strenuous duty because of high part load efficiency and shorter, more thermally stable construction.



Cross sectional view, showing two turns of typical supercharged conductor construction. The cooling gas is in intimate contact with the copper, removing the heat right where it originates. The heat does not have to migrate through insulation and surrounding metal to reach vent ducts in the rotor teeth or body.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

***FIRST* with Supercharged Hydrogen Cooling!**

Application engineering . . . *essential to control*

No matter what the product, every plant uses methods, materials and equipment that present problems peculiar to its own production. Specifications . . . size of plant . . . rate of output . . . all impose further unique restrictions.

What, then, about process control instrumentation? To do its job right, it has to be designed with all those factors . . . and many others . . . in mind. And here is where Honeywell Application Engineering steps in.

First comes a thorough investigation of control requirements. A Honeywell engineering representative, well versed in instrumentation techniques sits down with process engineers, production men, and instrument technicians . . . discusses details of the specific process. Then he puts the problem up to Honeywell's staff of application engineers.

Specialists for Each Industry

In this group are men who are expert in each specific industry. One group, for example, specializes in instrumentation for the metalworking industry . . . another for chemical . . . another for petroleum . . . until the whole gamut of modern manufacturing is represented. Each man has been trained, by education and first-hand experience, in the techniques of processing and process control in the area of his interest. Each is a living part of the industry he serves. And he knows why and where every process "is different."

Covers All Aspects of Control

Honeywell application engineering covers the entire control installation. It works out details of what instrument to use for each measurement or control function . . . what type of primary element . . . what control system . . . what size and style of valve. It provides all essential signals, safety interlocks, and accessories. It combines all these elements into a complete unit, arranged for peak production efficiency . . . greatest convenience of the operator, and for maximum ease of service . . . custom-fitted to the individual needs of the process to be controlled.

Saves Time . . . Produces Top Performance

This Honeywell service gives specialized consultation on complex control problems that would otherwise require the attention of experts in the individual plant. But most important, it assures a control system that will produce the superior performance that Honeywell instruments are capable of giving . . . and which will help to obtain the most production and best quality from the process which it serves.

Remote measuring *centralized*

SOUND PLANN'NG, *based on specialized engineering experience, forms the basis of Honeywell Application Engineering. Here a round-table discussion between customer and Honeywell technicians irons out the initial control requirements for a process.*

H HONEYWELL

WHEREVER you need to bring measurements of flow, liquid level and pressure from out in the plant to a central control room, you'll find Brown remote measuring systems provide the performance you need. Utilizing pneumatic transmission, these systems consist of an appropriate transmitter and sensing element at the point of measurement—connected by small-diameter tubing to recording and controlling instruments on the main or auxiliary control boards.

They're accurate: operate over distances of several hundred feet with full responsiveness. Transmitter and receiver are precision-matched in design.

They're dependable: rugged design keeps calibration constant, from detection to final measurement. Simple construction minimizes maintenance.

Brown pneumatic transmission systems are supplied in a wide choice of ranges for power plant service.

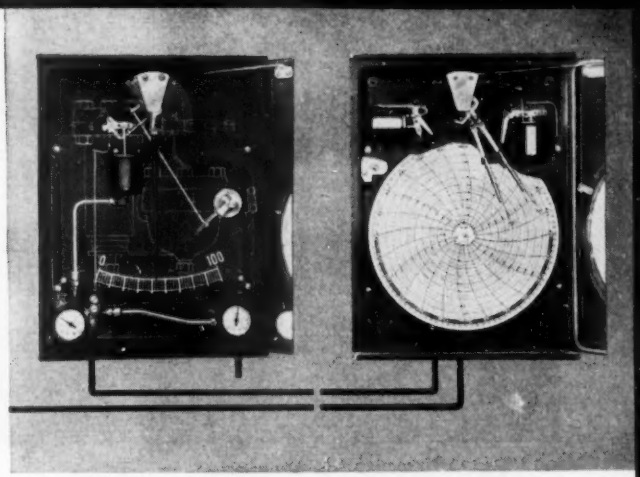
systems for *plant control*

Electric systems are also available for these same variables. Your local Honeywell engineering representative will welcome the opportunity to discuss your own plant's applications . . . and he's as near as your phone.

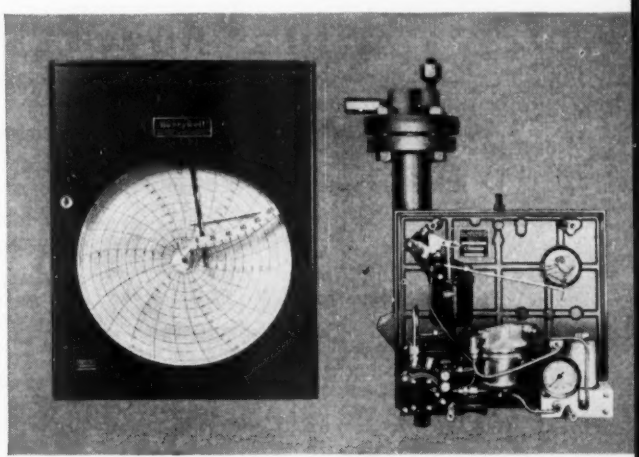
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa. Sales and service offices in more than 90 principal cities of the United States and Canada.

● **REFERENCE DATA: Write for Catalog 90-2, "Supervisory Instruments for Power Generation," and for Data Sheet No. 9.1-4.**

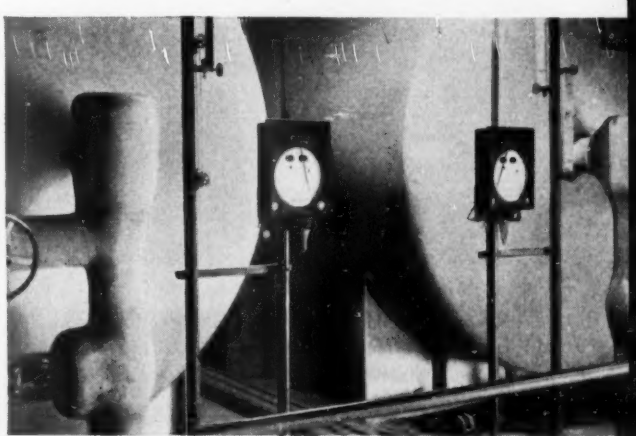
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



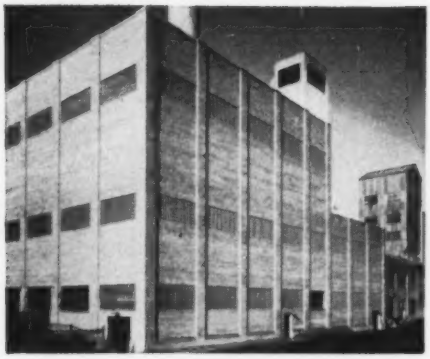
REMOTE PRESSURE MEASUREMENT: *Brown systems cover the range from super heat pressures to condenser vacuum. Only low-pressure instrument air goes to the control board. Dangers of high-pressure piping are eliminated . . . panel costs are reduced.*



REMOTE FLOW MEASUREMENT: *systems can be either the square root type (electric or pneumatic transmission) or evenly graduated (electric transmission). The latter is ideal for flow cost accounting . . . has a linear scale that provides full readability at all flow rates.*



REMOTE LIQUID LEVEL MEASUREMENT: *keep operators informed of level in condensate tanks, hot wells, boiler drums and other remote locations. Systems are supplied for open tanks, closed pressure vessels, corrosive liquids, and liquids containing suspended solids.*



THE AMALGAMATED SUGAR COMPANY, Rupert, Idaho
One 150,000 pound Detroit RotoGrate Stoker

THE AMALGAMATED SUGAR COMPANY, Nyssa, Oregon
Three 90,000 pound Detroit RotoGrate Stokers

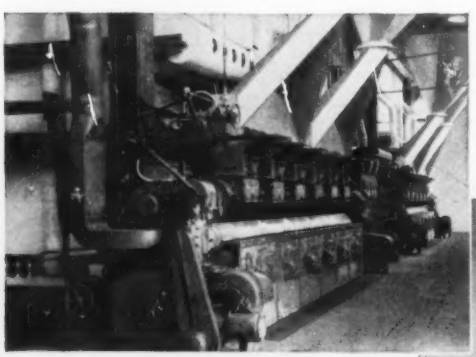
Detroit Stokers Burn Coal EFFICIENTLY in Many Food Product Plants

Repeat order customers are the best evidence of satisfactory performance of Detroit RotoGrate Stokers and Detroit RotoStokers—spreader stokers that burn a portion of the fuel in suspension—the balance on grates of special design.

They Provide These Features You Need In A Stoker:

- Burn any Bituminous Coal or Lignite without special preparation.
- Increase capacities due to higher burning rates.
- Provide exceptional fuel economy.
- Are exceedingly responsive to fluctuating loads.
- Operate with low auxiliary power.
- Coal feed and air supply are automatically controlled.
- Operate with preheated air if desired.
- Availability high . . . Maintenance low.

Do you need more steam? If so, investigate and order your Detroit Stokers now. Write for Bulletin—No Obligation

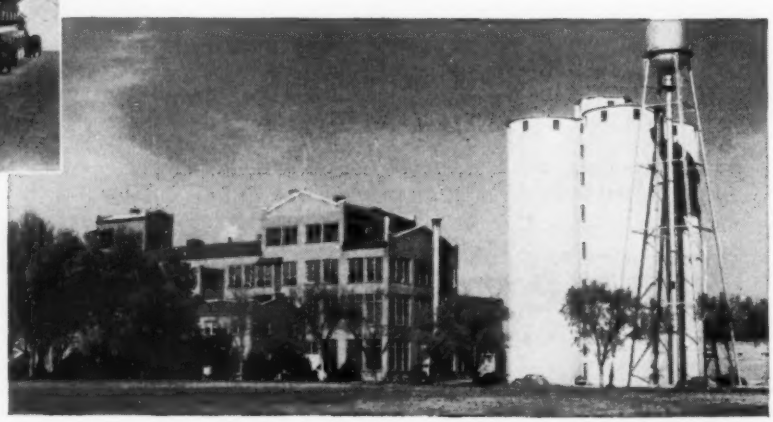


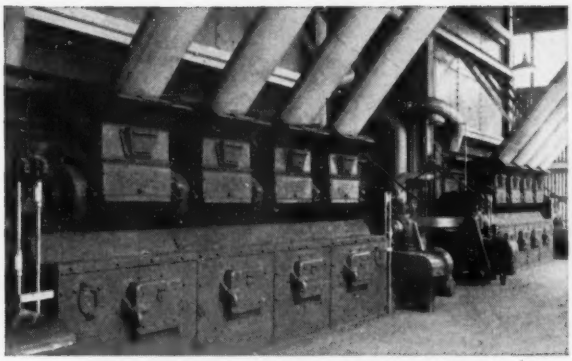
GREAT WESTERN SUGAR COMPANY,
Fort Morgan, Colorado
Two 102,500 pound
Detroit RotoGrate Stokers

DETROIT STOKER COMPANY

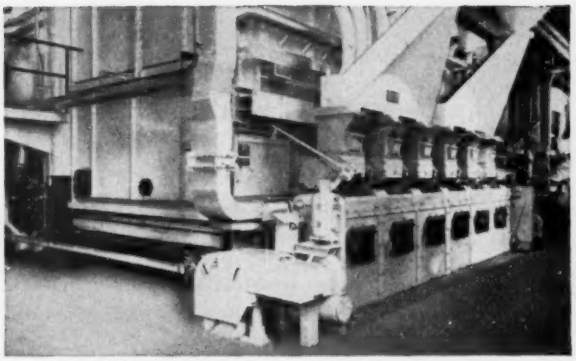
GENERAL MOTORS BLDG., DETROIT 2, MICH.

District offices in Principal Cities • Works in Monroe, Mich.





UTAH IDAHO SUGAR COMPANY, Garland, Utah
Two 100,000 pound Detroit RotoGrate Stokers



GREAT WESTERN SUGAR COMPANY, Longmont, Colorado
Two 150,000 pound Detroit RotoGrate Stokers

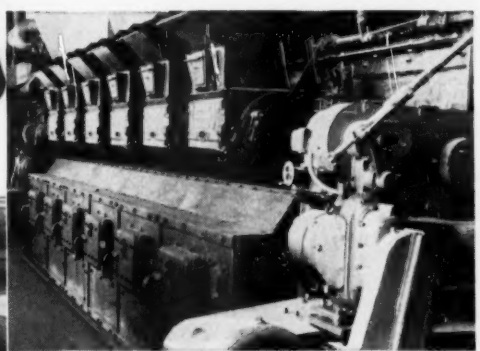
It's What USERS Say That COUNTS . . . FOOD PLANTS LIKE DETROIT STOKERS

★Repeat Order Plants

★Amalgamated Sugar Company
★American Crystal Sugar Company
★Armour & Company
★Borden Company
California Packing Corporation
Campbell Soup Company
The Capital City Products Company
★Central Soya Company, Inc.
W. N. Clark Company
★Clinton Industries, Inc.
★Cranberry Canners, Inc.
Cudahy Brothers Company
DuQuoin Packing Company
J. A. Folger Company
Forbes Brothers—Central Mills Inc.
★General Foods Corporation
General Mills, Inc.
★Great Lakes Sugar Company
★Great Western Sugar Company
Gunnison Sugar, Inc.
Hawaiian Commercial & Sugar Co. Ltd.
★Illinois Meat Company
★International Salt Company
★The Keever Starch Company
Lake Shore Sugar Company
★Libby, McNeill & Libby
Manistee Salt Works
★Oscar Mayer & Company
Menominee Sugar Company
★Michigan Sugar Company
Monitor Sugar Company
Morton Salt Company
National Fruit Products Company
National Oats Company
★National Starch Products, Inc.
National Sugar Manufacturing Company
★G. M. Peet Packing Company
★Planters Nut & Chocolate Company
Quaker Oats Company
★Ralston Purina Company
★The Rath Packing Company
Russell Miller Milling Company
J. R. Short Milling Company
★Stokely Foods, Inc.
Sugardale Provision Company
★G. S. Suppiger Company
★Swift & Company
Tobin Packing Company, Inc.
★Utah-Idaho Sugar Company
Vincennes Packing Company
Western Grocer Company
★Wilson & Company, Inc.

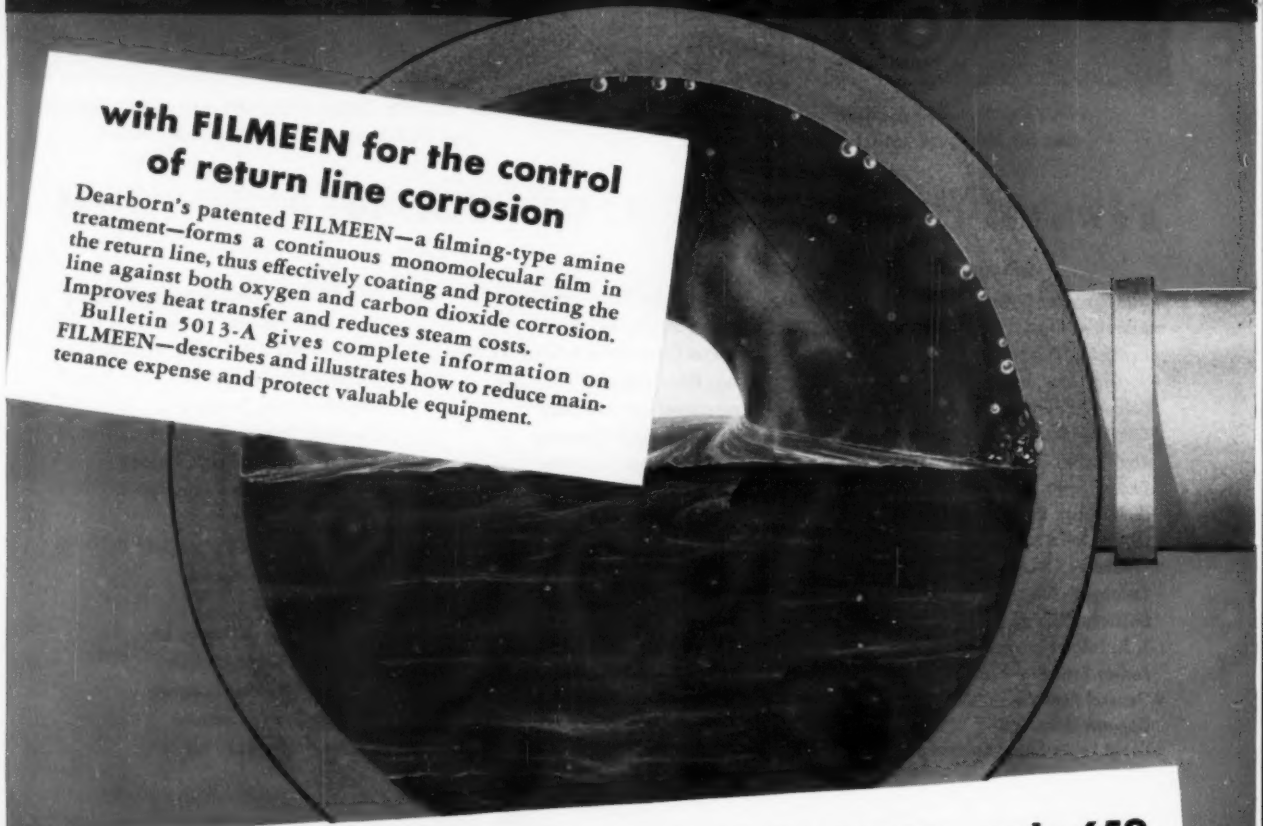
There is a type and size of Detroit Stoker for every Industrial need.

DETROIT SINCE 1898 STOKERS



AMERICAN CRYSTAL SUGAR COMPANY,
Moorhead, Minnesota
Two 90,000 pound Detroit
RotoGrate Stokers

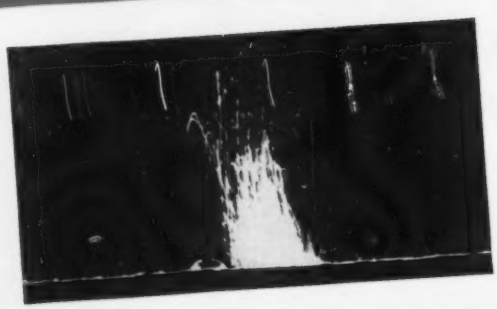
How Dearborn Helps



with FILMEEN for the control of return line corrosion

Dearborn's patented FILMEEN—a filming-type amine treatment—forms a continuous monomolecular film in the return line, thus effectively coating and protecting the line against both oxygen and carbon dioxide corrosion. Improves heat transfer and reduces steam costs.

Bulletin 5013-A gives complete information on FILMEEN—describes and illustrates how to reduce maintenance expense and protect valuable equipment.



with DEARBORN Formula 659

Boilers, feed lines, heaters and economizers are protected against sludge accumulations—steam purity control is assured—turbine deposits are effectively prevented—with Dearborn's Formula 659 Sludge Conditioner and Polyamide Anti-Foam Treatment. Safeguards against carry-over of suspended and dissolved solids. Protects valuable parts—avoids expensive maintenance and unnecessary shutdowns. Bulletin 5008 tells the complete story.

Dearborn

TRADE MARK

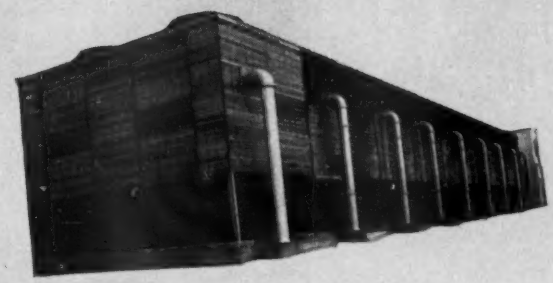
COMBATTING CORROSION EVERYWHERE SINCE 1887

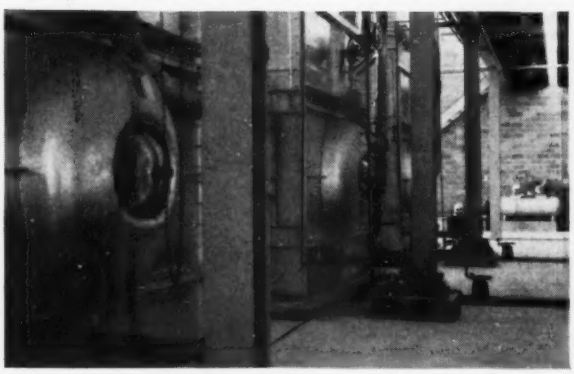
DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Make Water Behave!

COOLING WATER for testing jet aircraft engines is treated by DEARBORN

Here is one of the giant 500,000 gallon cooling water towers operated by the National Advisory Committee for Aeronautics. To prevent scale formation, corrosion and delignification of the wood, properly conditioned water was necessary. Dearborn engineers did the job...analyzed the raw water, and specified the correct treatment, test equipment and controls.



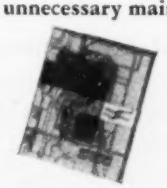


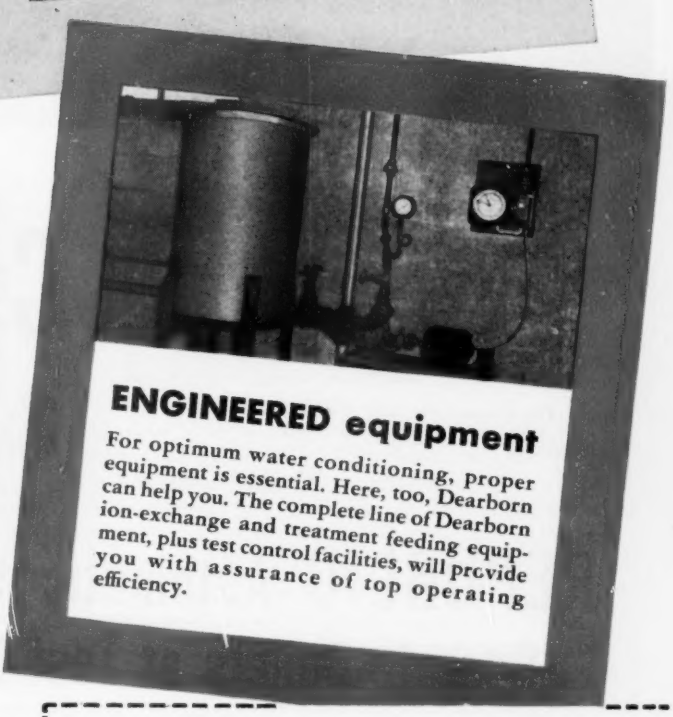
with DEARBORN'S complete water treatment and engineering service

Providing trouble-free water—a vital necessity to every user of steam—has been Dearborn's business for more than 65 years.

Today, this broad background of experience—plus treatment formulas that have been tested and re-tested and the most modern laboratory and research facilities—is available to you at Dearborn.

To keep your power and steam-producing facilities at peak production...to greatly minimize unnecessary maintenance—call your Dearborn Sales Engineer. He's our expert who will check your facilities—analyze your raw water—recommend the proper treatment, feeding equipment and test procedure. Dearborn Bulletin 5000 describes this service.





ENGINEERED equipment

For optimum water conditioning, proper equipment is essential. Here, too, Dearborn can help you. The complete line of Dearborn ion-exchange and treatment feeding equipment, plus test control facilities, will provide you with assurance of top operating efficiency.

Dearborn Chemical Company—Dept. PO
Merchandise Mart Plaza, Chicago 54, Illinois

Please send me

☐ Bulletin 5013-A ☐ Bulletin 5008 ☐ Bulletin 5000

☐ Have a Dearborn Sales Engineer call

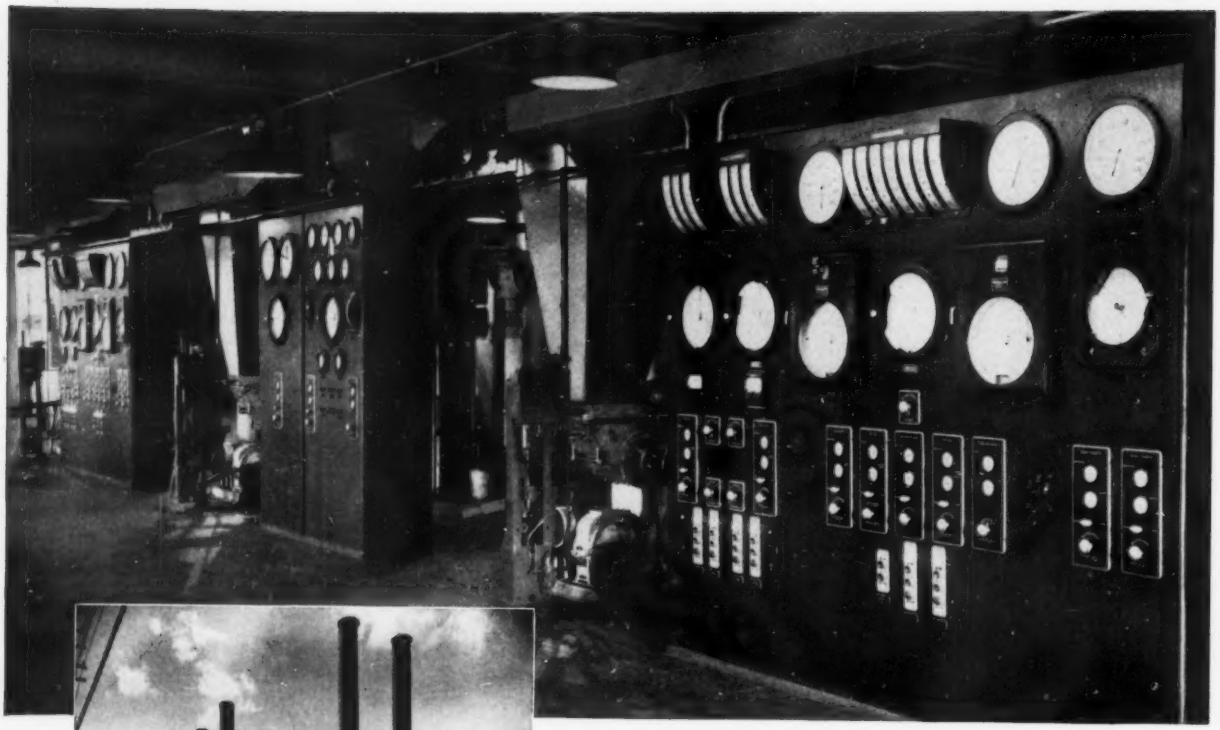
Name.....

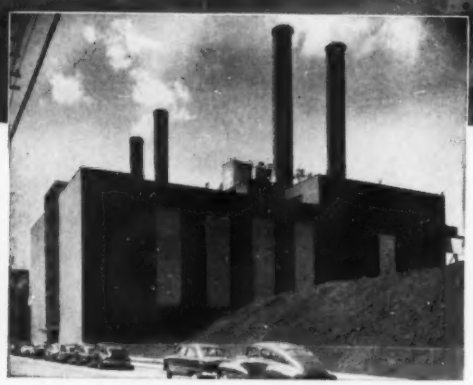
Company.....

Position.....

Address.....

City.....*State*.....





The Jamestown plant is efficient and modern, inside and out.

Control and

AT JAMESTOWN, NEW YORK MUNICIPAL LIGHT PLANT

REPUBLIC Automatic Combustion Controls Operate Boilers at Test Efficiency to:

SAVE FUEL **by maintaining maximum combustion efficiency continuously.**

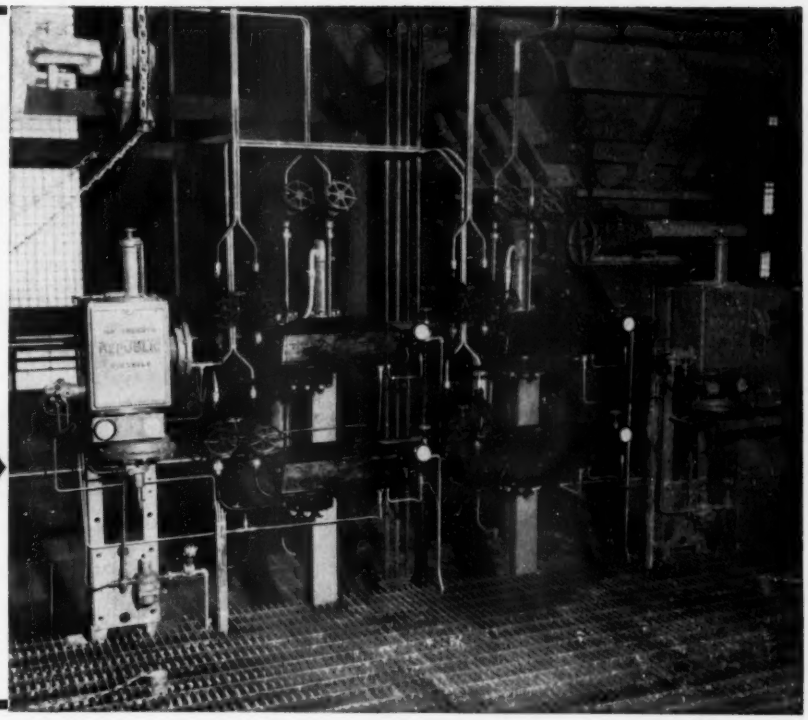
SAVE MAINTENANCE AND EQUIPMENT **by holding uniform operating conditions. Chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation is prevented.**

SAVE MANPOWER **by automatically performing many repetitive adjustments.**

HIGHLY IMPORTANT **during this critical power shortage, the Jamestown plant meets peak load demands because, with REPUBLIC Combustion Controls, it gets all of the steam output the plant boilers are rated for.**

These panels are part of the REPUBLIC Automatic Control System that is used exclusively in the Jamestown plant. When desired, manual operation of the entire boiler system can be made from this location. Panel in the center houses master gauges and other coordinating equipment while panels on either side contain gauges, meters and controls for boilers. REPUBLIC Positioners at left of each panel vary rate of coal feed to pulverizers.

REPUBLIC Regulators and Flow Transmitters are used in the two-element feedwater control system. Rate of feedwater flow to the boiler is changed immediately with a change of either steam flow or feedwater drum level.



Savings are Automatic

At the Jamestown, New York, Municipal Light Plant, two 150,000 lb. per hr. boilers rated at 900 psig. and 900° F.T.T. supply steam to a 20,000 kw turbine. Steam at 275 psig. and 600° F.T.T. is also supplied through a pressure reducing and desuperheater station to an adjoining older plant.

For maximum efficiency and performance, the entire plant is under automatic control. Steam pressure at the turbine is maintained constant and combustion is held at maximum efficiency for steam loads varying from 40,000 lb. per hr. to 165,000 lb. per hr. Both the Automatic Combustion Control System and the pressure reducing and desuperheater station were furnished by REPUBLIC FLOW METERS CO.

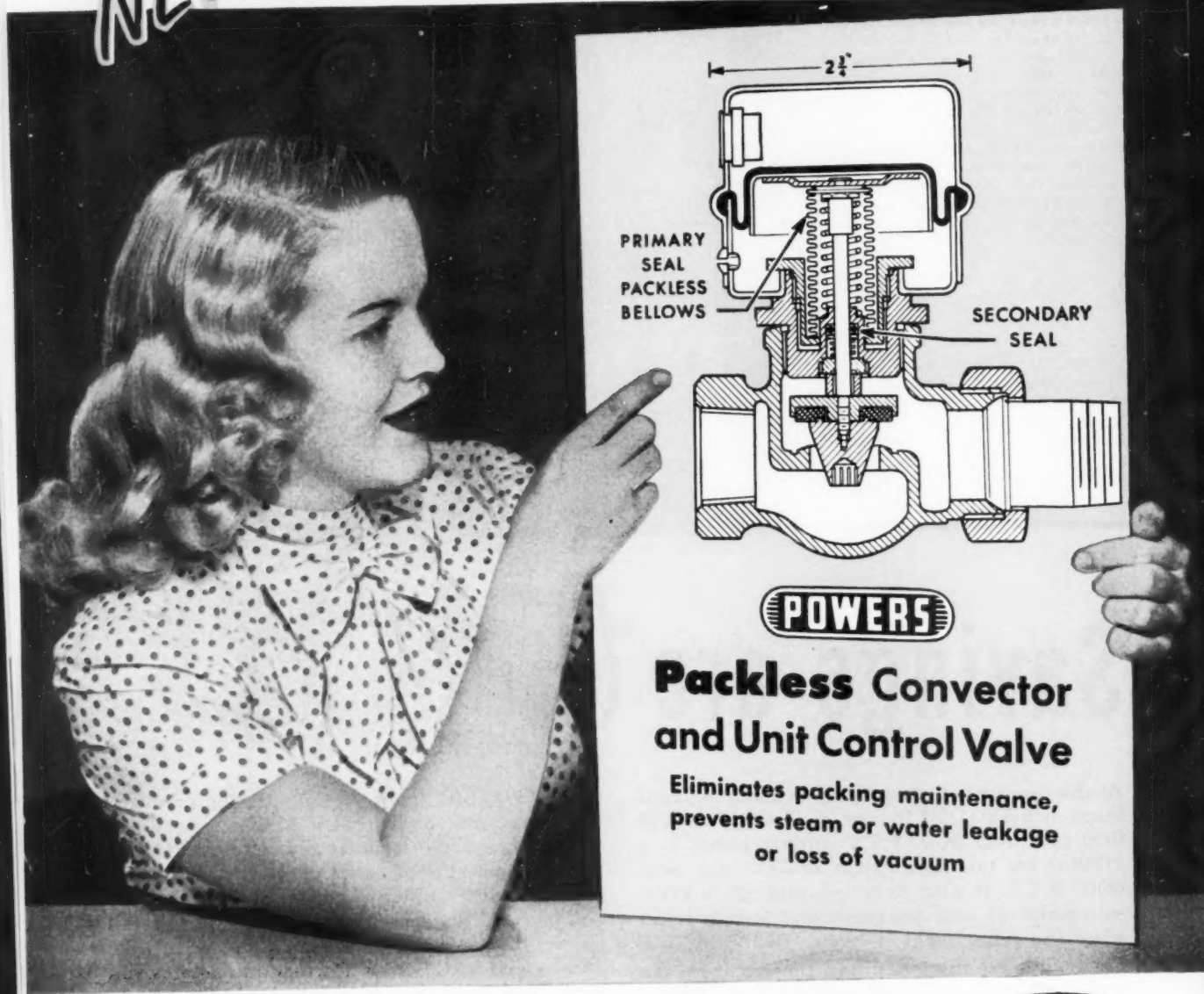
ONE OF MANY

This is but one of many power plants that rely on REPUBLIC Instruments and Controls. For more than 37 years, REPUBLIC has specialized in the design and manufacture of automatic control systems for all sizes of power generating stations. REPUBLIC Controls are available for all types of boilers and auxiliary equipment, all kinds of fuel firing (both for single or multiple fuels) and for all load fluctuations. When you specify REPUBLIC Controls, you get the benefit of this complete line of equipment and the services of an experienced engineering staff who know how to put that equipment to use to give you the control system that best meets your requirements.

For complete information about REPUBLIC Automatic Control Systems, send for Data Book S-21 or contact our field engineer nearest you. There's no cost or obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

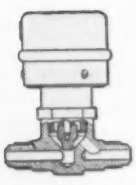
NEW! POWERS PNEUMATIC *Systems of*

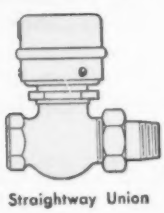


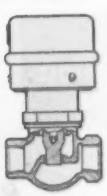
POWERS

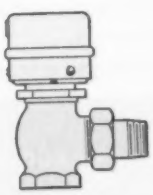
Packless Convector and Unit Control Valve

Eliminates packing maintenance, prevents steam or water leakage or loss of vacuum


Flared Ends


Straightway Union

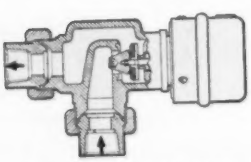

Screwed Ends

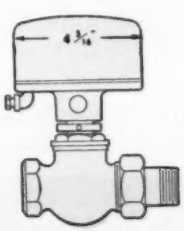

Angle Union

POWERS-PACKLESS-VALVES

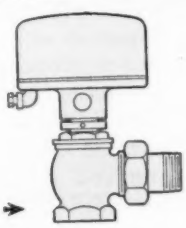
Never require re-packing.

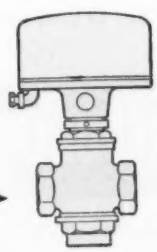
Real Economy in Maintenance year after year


Reverse Flow Double Union



Straightway Union


Angle Union


3-Way Screwed Ends

Available in various types and sizes for control of convectors, unit ventilators, unit air conditioners and radiators.

Automatic Temperature Control
Now Include

POWERS-**PACKLESS**-VALVES

For Controlling Convectors, Unit Ventilators, Unit Air Conditioners and Radiators.

Now, at NO Extra Cost — users of Powers pneumatic control systems will get the additional benefits of still lower operating and maintenance costs — insured by Powers packless valves.

Duo-seal Construction Gives Them Superior Performance. Bronze packless bellows is the Primary Seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. Secondary Seal permits servicing of valve top without draining the water system or shutting off the steam supply.

Typical Specifications for POWERS-Packless-Pneumatic Control Valves

Control valves for convectors, radiators and unit ventilators shall be packless type with bronze packless bellows to eliminate steam and water leakage or loss of vacuum. This packless bellows shall be located so that it is not subject to corrosive action of the steam or water. A spring-loaded secondary seal shall be provided to permit convenient inspection or servicing of valve top without draining the water system or shutting down the steam supply.

Valve sizes shall be determined by control manufacturer for capacities specified. Type of valve body and valve top to be used shall be as required to best satisfy the application.

Valves shall be equipped with phosphor bronze bellows or Neoprene diaphragms of sufficient size to close off against specified line pressures. Diaphragms shall be replaceable. Valves shall be equipped with characterized throttling plugs to insure a measured flow of steam or water in direct relationship to the demand of the controlling thermostat.

THE POWERS REGULATOR CO.

Skokie, Ill. • Offices in Over 50 Cities in the U. S. A., Canada and Mexico

See Your Phone Book

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

Banish PACKING Maintenance

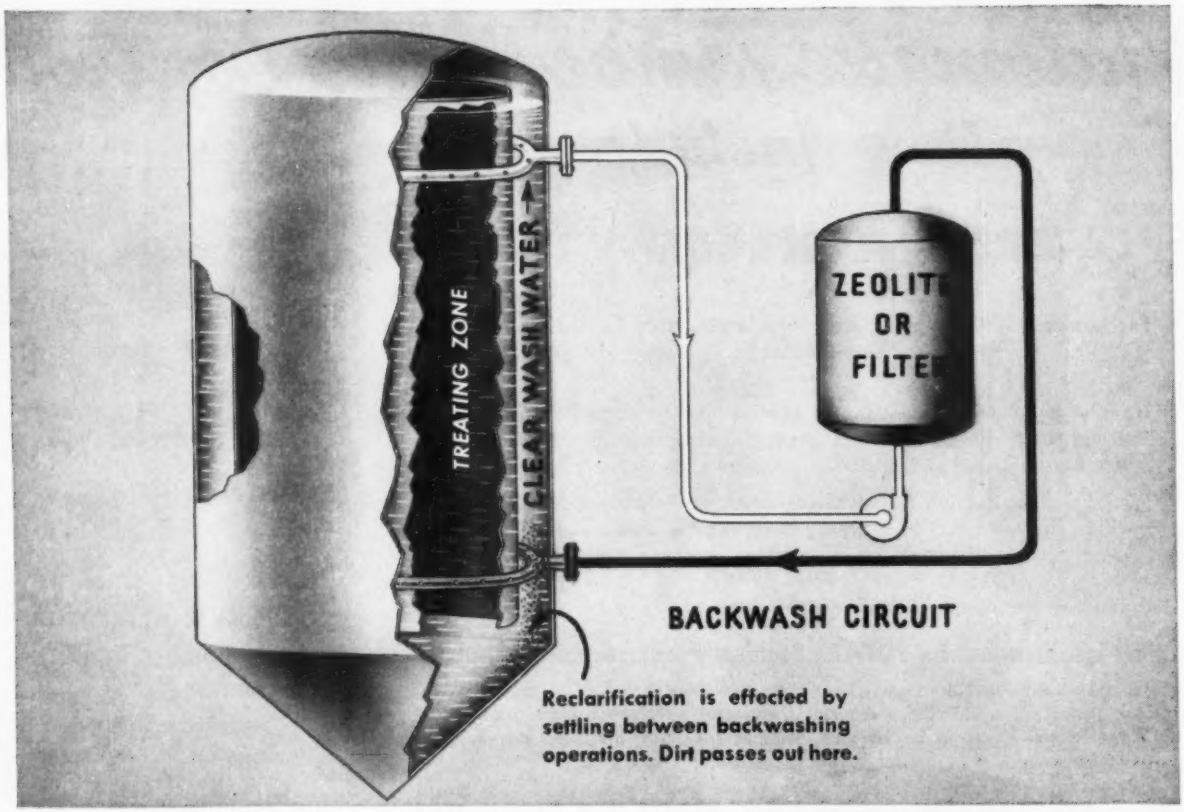
No Loss of Vacuum

... leakage of air reduces efficiency of heating system and increases corrosion in return lines

No Steam or Water Leakage

(b18)

Only a Few of **POWERS** Complete Line of Modern Control Valves for Regulating Heating and Air Conditioning Systems


TREATING ZONE
CLEAR WASH WATER
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.

BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in, annular wash-water compartment* provides clean, hot, chemically inert water for backwashing and reclaims it without affecting operating velocities in treating zone, or subjecting hot zeolite to temperature changes. Backwashing is accomplished by recirculation of the clarified wash water.
*Reg. U.S. Pat. Off. 2,263,398

You can't wash clean with dirty water!

How Worthington Hot-Process Water-treating systems backwash with CLEAN, hot, chemically inert water

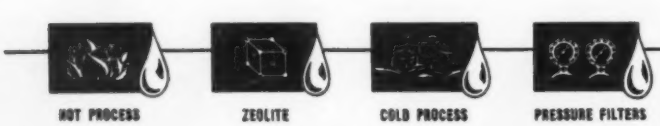
When you're considering hot-process water-treating systems with hot zeolite, filters, or both, *don't overlook backwashing facilities.*

They must be well designed, or the system cannot give smooth, efficient, trouble-free performance. Worthington engineers recognized this fact when they designed their first hot-process system. Today, every Worthington standard Hot-Z or conventional system provides exclusive *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water without disturbing the normal flow through the reaction bank.

Worthington water-treating specialists don't believe you can wash clean with dirty water.

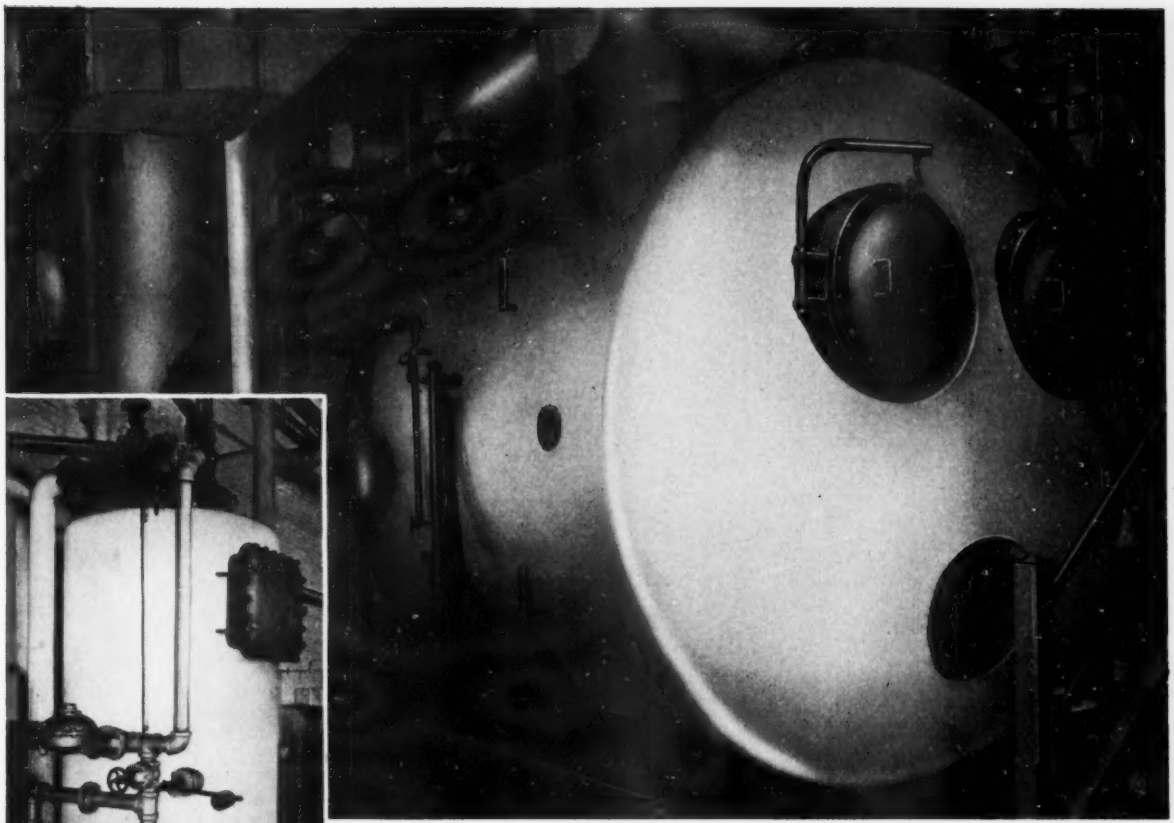
This unique backwashing provision is just one of many Worthington patented features, but it alone will more than justify your selection of a Worthington system for hot-processing boiler feedwater in your plant.

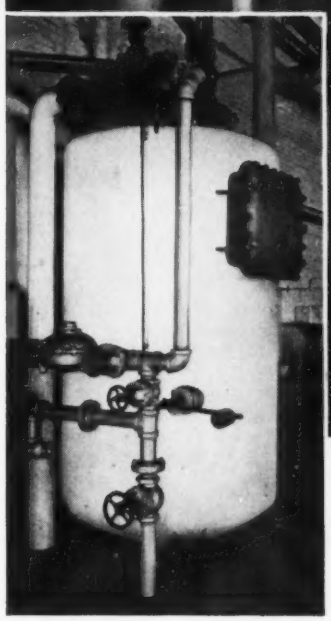
If you have a problem, whether it involves filtration, precipitation, or zeolite treatment, Worthington specialists will be happy to study your water-treating problem and recommend the proper system. Just write, stating service conditions in detail, to Worthington Corporation, Water Treating Division, Harrison, N. J. J.3.1



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON
Water Conditioning





A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

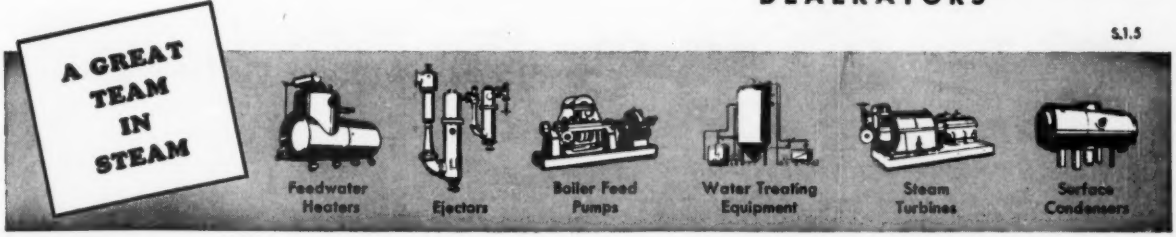
Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

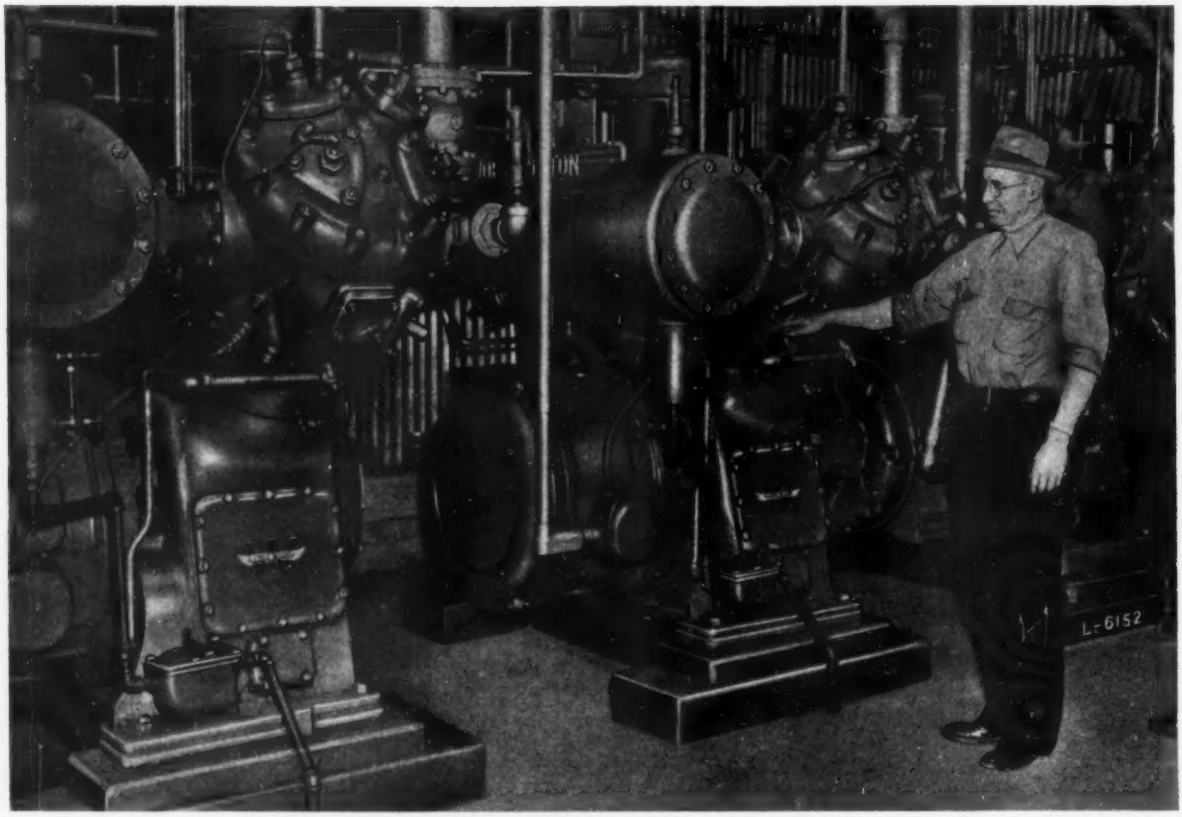
Send your water treating problem to Worthington Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

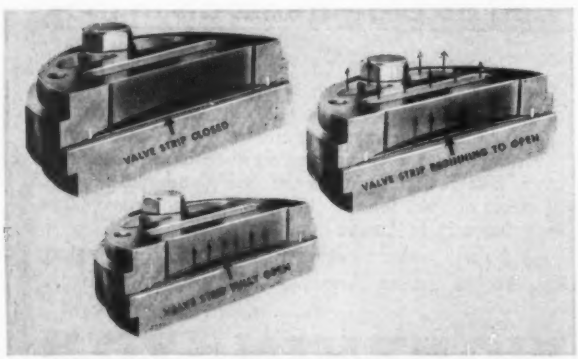
S.1.5





WORTHINGTON TYPE YC-2 COMPRESSORS supplying compressed air for the Coos Bay, Oregon plant of the Evans Products Company. These units are supplied with high-efficiency Three Step Variable Capacity Control.

Coos Bay plywood plant smooths out vibration problem



THE QUIET-OPERATING WORTHINGTON FEATHER* VALVE is made up of a series of thin flexible strips of ribbon steel, held in position over rectangular openings, by curved milled guards. The valve strips lift and flex uniformly against the curved guards. In addition to quiet operation, the absence of impact results in long valve life and low maintenance costs.

Heavy vibration had caused tube trouble in the steam generating equipment at the Coos Bay, Oregon, plant of the Evans Products Company.

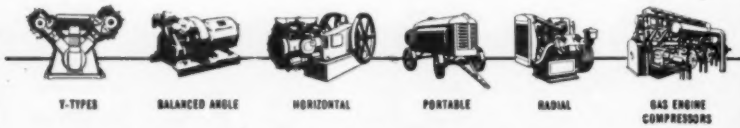
When it came time to install new compressors in this critical area, plant engineers solved their problem by choosing two quiet-running Worthington YC-2's.

After three years, the low-vibration performance of the two Worthingtons was so satisfactory that another YC-2 was ordered and installed this year—making an all-Worthington compressor installation.

Contributing to the smooth operation of Worthington compressors are the exclusive Worthington Feather* valves—the lightest, simplest and most efficient valves ever developed for compressor operation. Valve seating is always quiet and positive.

Write us about your compressor problem. Worthington Corporation, Compressor Division, Section K.3.1, Buffalo, New York. K.3.1

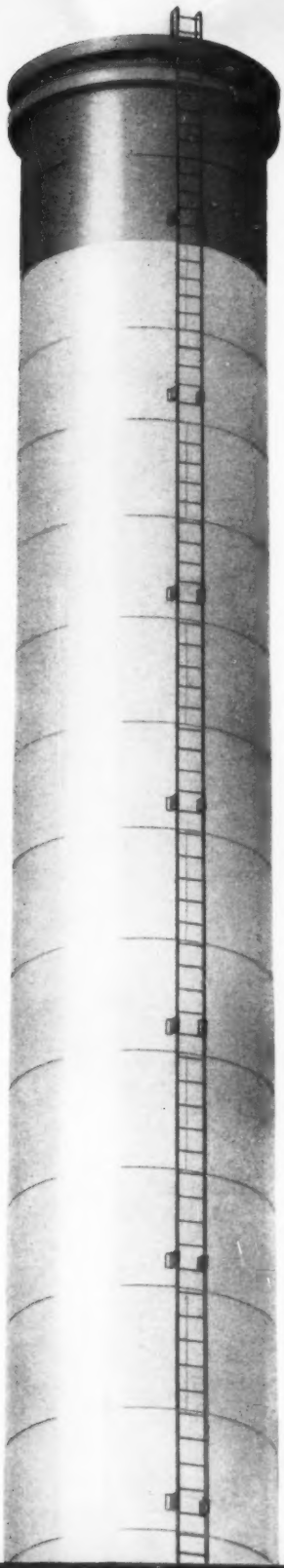
*Reg. U. S. Pat. Off.



ONLY WORTHINGTON COMPRESSORS GIVE YOU FEATHER VALVE PERFORMANCE

WORTHINGTON
Compressors

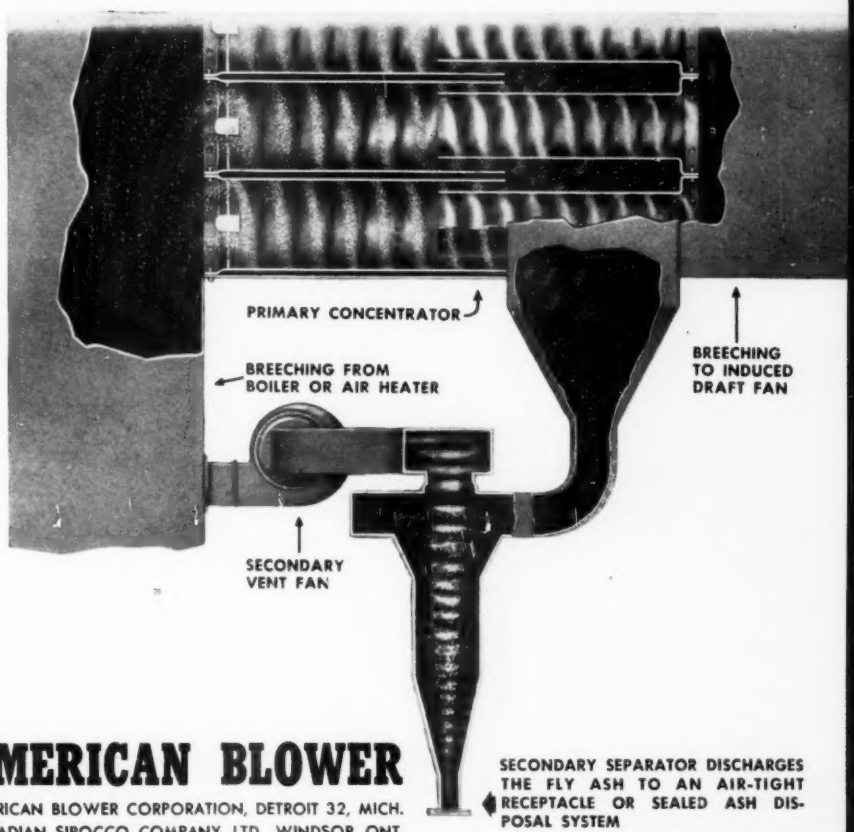
American Blower . . . a time-honored name in air handling



Proved procedure for minimizing a nuisance

Important power plants all over the country have found this procedure helpful in solving their fly-ash problems. You will, too. Here's all you have to do:

1. Contact your nearest American Blower or Canadian Sirocco Branch Office. They are conveniently located throughout the United States and Canada.
2. Our competent engineers will show you (or your engineering counsel) the advantages of installing Type ST Fly Ash Precipitators to meet your specific needs.
3. Your precipitators will be completely assembled at the factory, then partially disassembled into convenient sections and shipped to your plant for installation.


PRIMARY CONCENTRATOR
BREECHING FROM BOILER OR AIR HEATER
BREECHING TO INDUCED DRAFT FAN
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR-TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

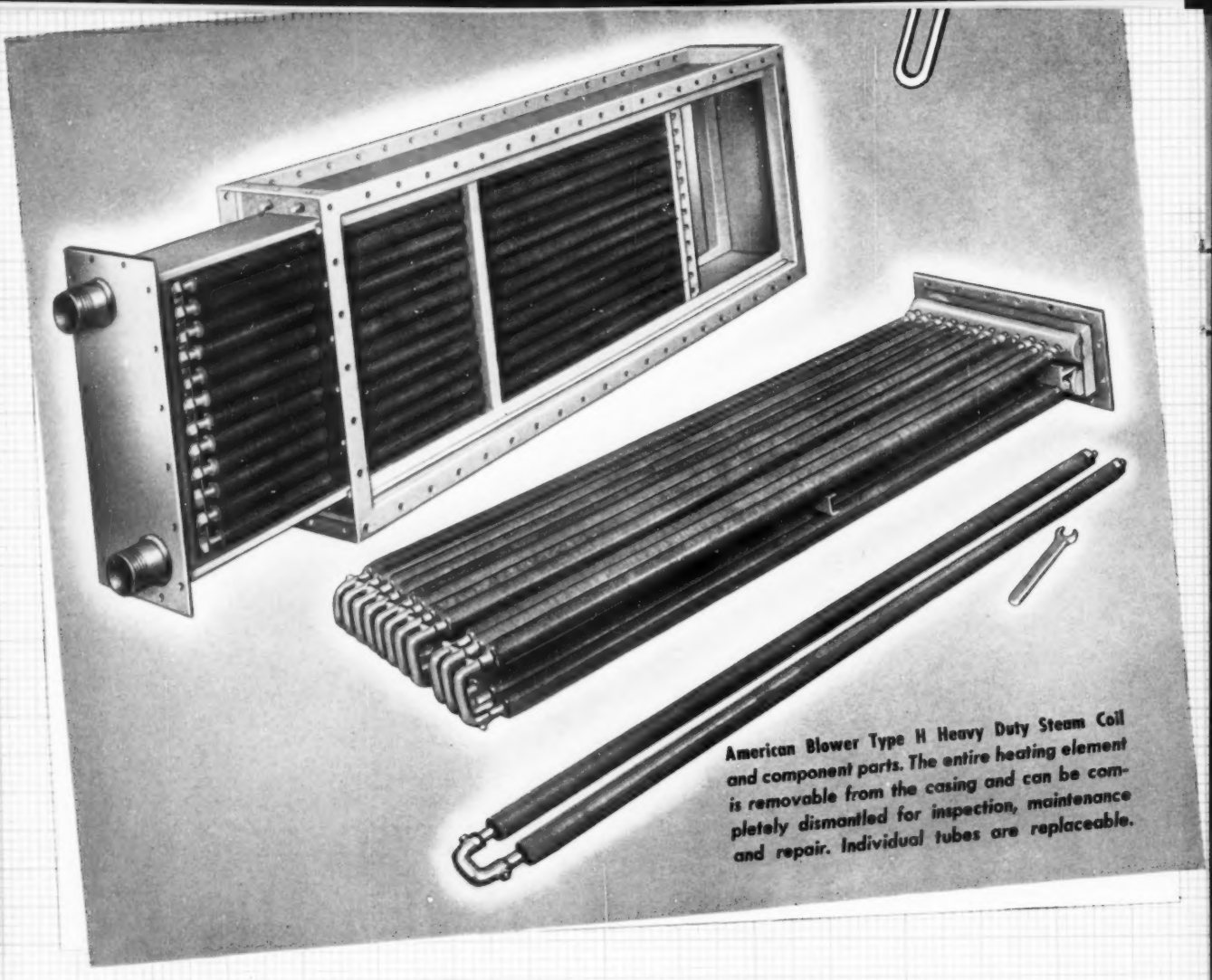
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS HEATER



American Blower Type H Heavy Duty Steam Coil and component parts. The entire heating element is removable from the casing and can be completely dismantled for inspection, maintenance and repair. Individual tubes are replaceable.

Memo to Power Plant Men —

American Blower Heavy Duty Steam Coils were developed for you for the sole purpose of providing a heating coil possessing great strength ... corrosion resistance ... ease of maintenance, and complete accessibility.

For heavy loads at high pressures, investigate them now!

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

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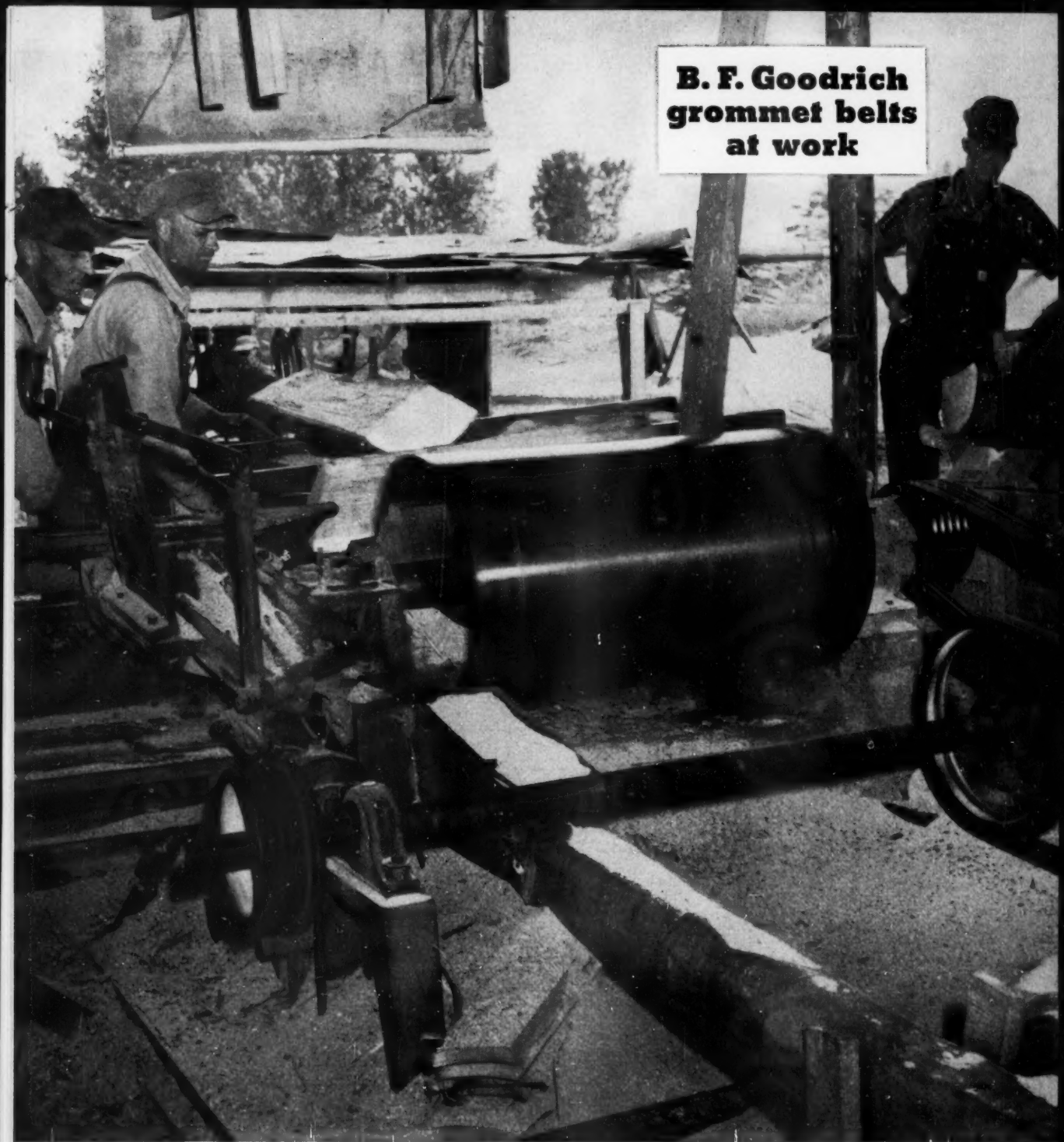
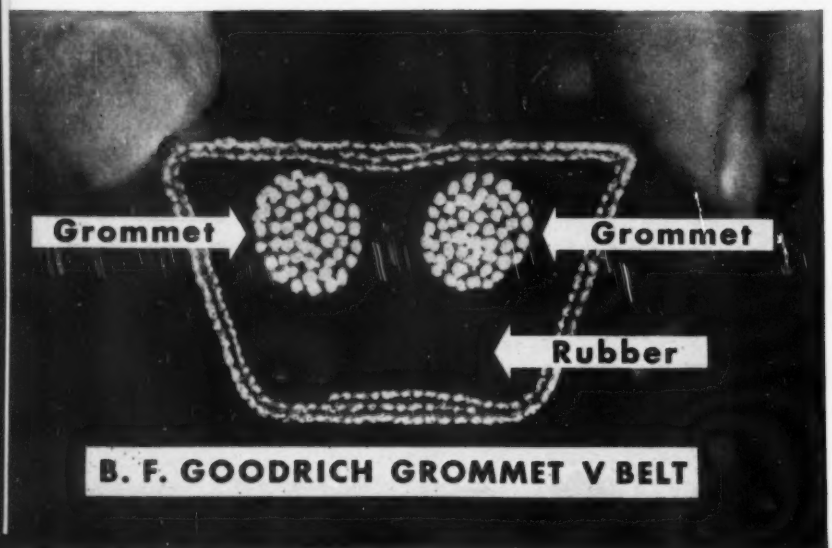


"Making little ones out of big ones"—staves for whiskey barrels cut from oak logs at Jordan Stave Mill, Hannibal, Missouri.

Sawdust trail that's no circus

Sawdust and splinters fly as cylinder-shaped saw cuts curved barrel staves from oak logs. These saws whirr all day, every day—and it's tough work. When the saws were installed, engineers knew that ordinary belts wouldn't take the sudden jerks as metal bit into wood. Slippage and failure to maintain constant speed were predicted. But as you'll see on the following page, the company found a type of belt which has avoided problems common to ordinary belts.

Belts take the jolts as metal bites into tough oak. Curved, cylinder-shaped saw cuts staves lengthwise and on a curve.



The sawmill described on the preceding page has been operating for over two and a half years, has never stopped production due to belt breakdown. Reason—B. F. Goodrich grommet V belts were selected for the job. The constant speed necessary for smooth cutting is maintained with no belt slippage or stretching. The grommet belt is a typical B. F. Goodrich improvement—saves money and does jobs better for industries of all kinds.

20 to 50% longer life

Grommet V belts, made only by B. F. Goodrich, represent the only basic improvement since invention of the

V belt. Belts last 20 to 50% longer, depending on the service. (The more severe the service the greater the increase over ordinary belts.)

What is a grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All cords put to work

In ordinary belts under high tension the center cords "dish" and tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Each grommet and every part of a grommet carries its share of the load. Grommet V belts have no center cords — therefore much more strength in proportion to cord volume.

Better grip, less slip

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip there is also less surface wear.

They cost no more

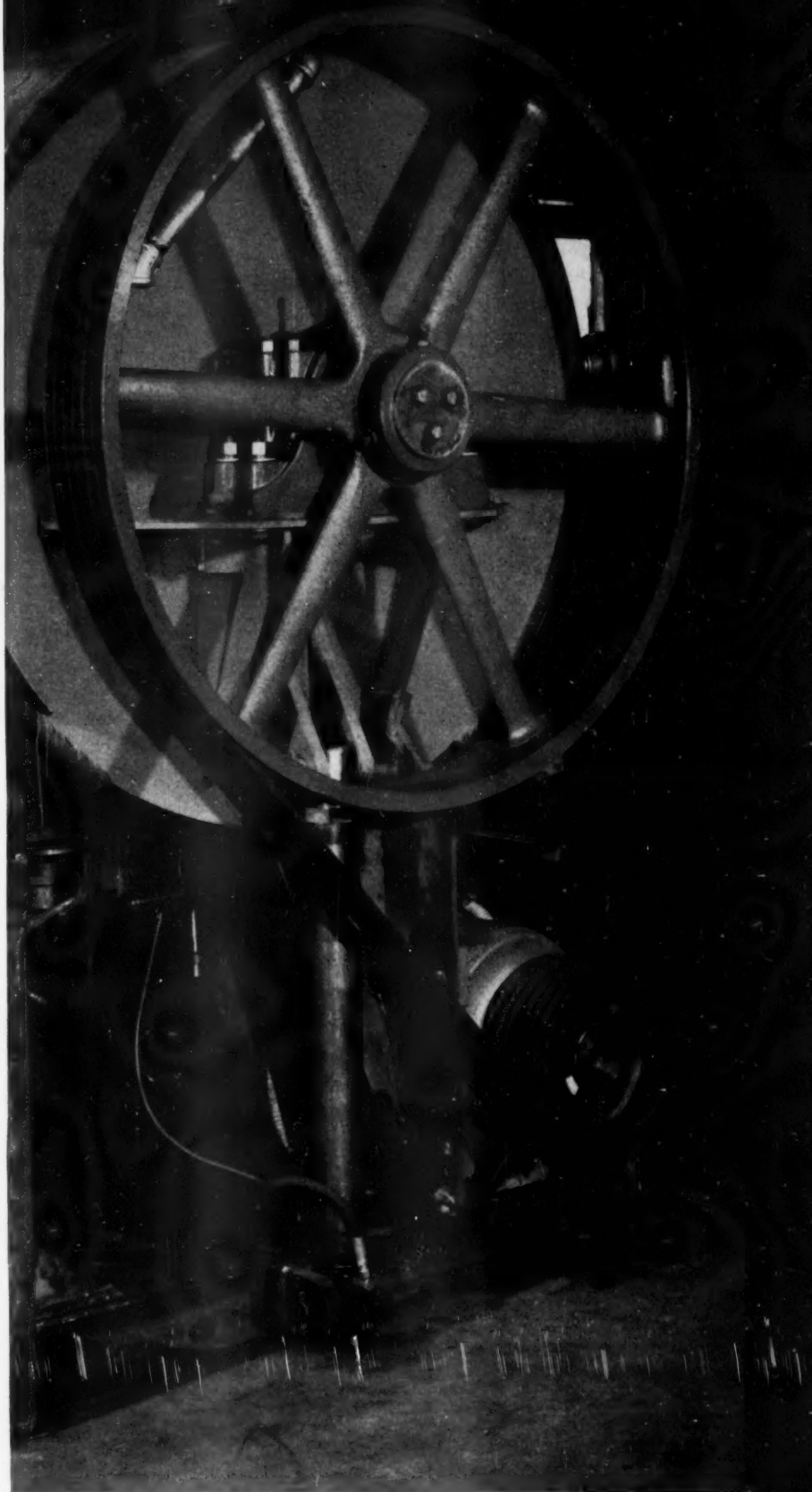
You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. Only B. F. Goodrich makes the grommet V belt.

See "X-ray" belt

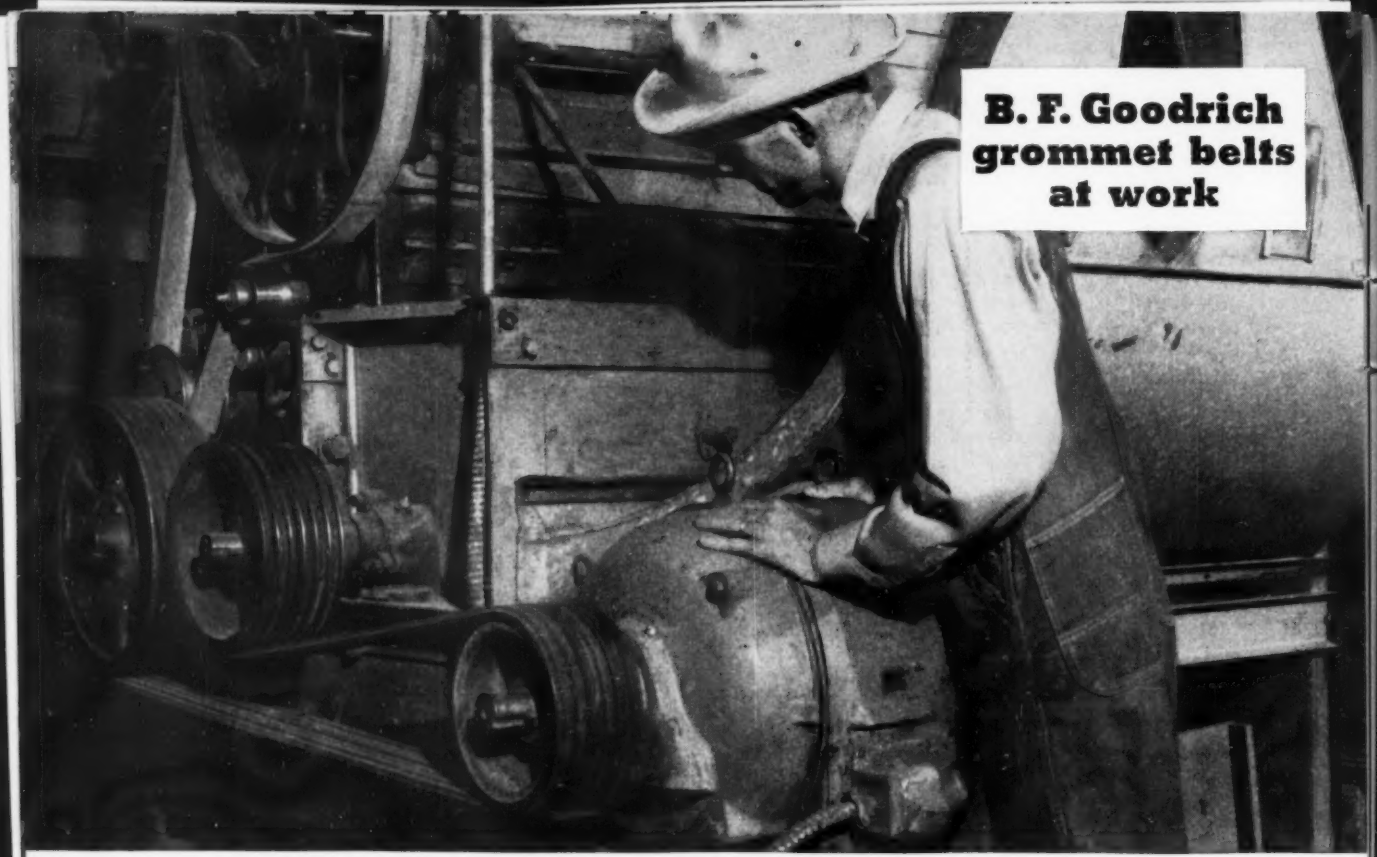
A special demonstrator "X-ray" belt has been made to show the grommet construction. Ask your local B. F. Goodrich distributor to show it to you.

Paul Bunyan laundry ➤➤

It takes a lot of pull-and-push to keep this big commercial laundry machine in motion. The drum turns first in one direction, then is stopped by the motor and belts and starts up in the opposite direction. The stopping and starting is the tough part of the job; ordinary belts slipped. That meant more maintenance, less efficiency. When a B. F. Goodrich distributor suggested the change to grommet V belts he solved all those problems at once. Now, The Miller Laundry Machine Company puts grommet V belts on all their machines. They've learned grommet belts wear longer, their customers have no trouble with Miller Laundry equipment.



Grommet V belts ended belt slippage for this big washer.



Belt failures used to cause shutdowns at San Joaquin Cotton Oil Co., Chowchilla, Calif.

Cottonseed barber

This machine shaves cotton fuzz from cottonseed. Flat belts previously used to drive a battery of these delinter machines would slip. This caused excessive wear. Belt life was short and breakdowns were common. Individual drives—using grommet V belts—were installed on all the machines. The grommet V belts far outlast the old fashioned flat belts. So belt cost and maintenance is less. Production is greater. And the change saved floor space and made safer working conditions by eliminating the dangerous network of flat belts.

These typical examples (see preceding pages) tell you why B. F. Goodrich grommet belts are superior to ordinary V belts—prove they last 20 to 50% longer—yet cost no more.

The B. F. Goodrich Company
Department M-24
Akron, Ohio

☐ Send set of reports telling users' experiences and showing actual installations where grommet belts outlasted all others.

☐ Please have a BFG distributor call. I'd like to find how I can save money with grommet V belts.

Name_____

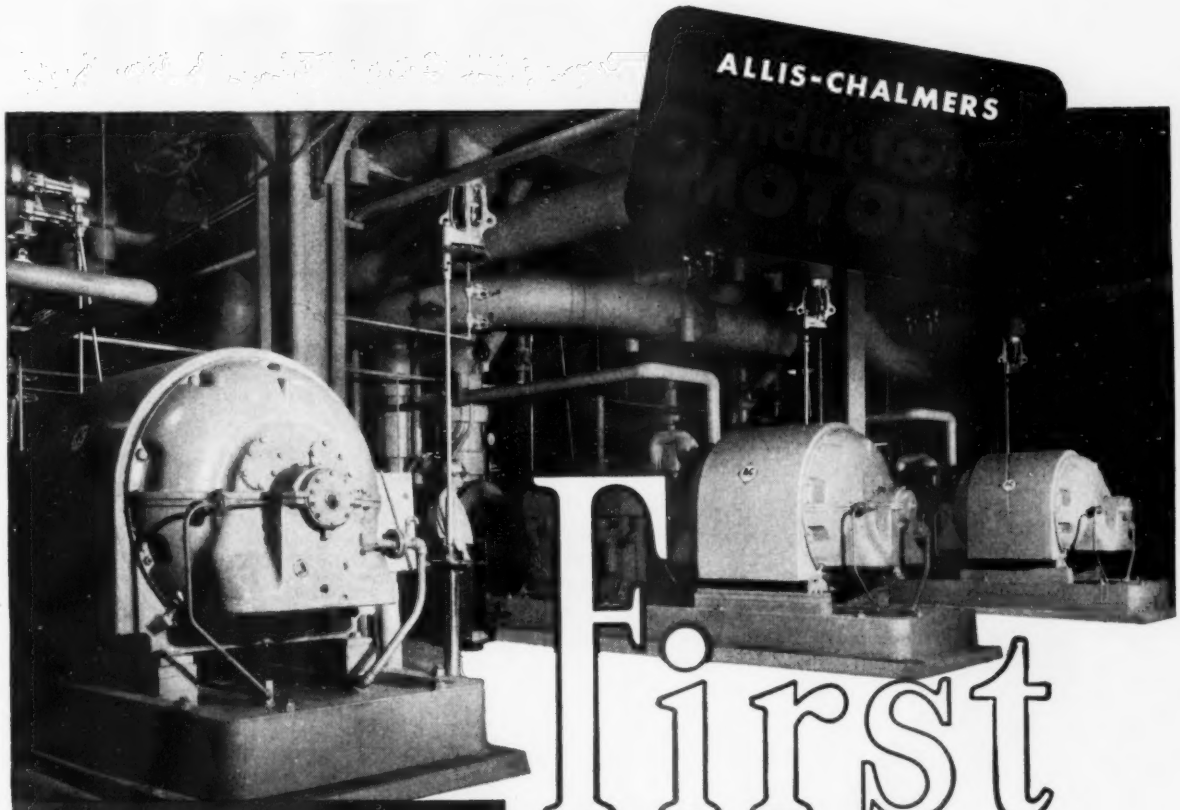
Firm Name_____

Address_____

City_____ Zone_____

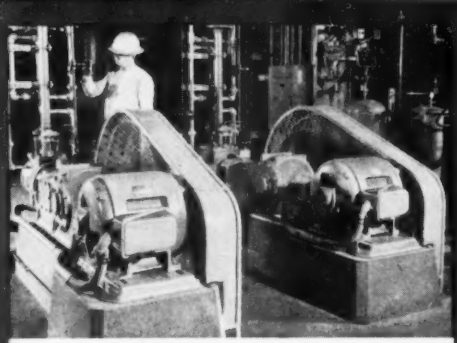
State_____

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER



First

OF THREE TRIPLETS



Suggested

INDUCTION MOTOR BULLETINS

Drip-proof and splash-proof (End-shield bearing)	½ — 100 hp	51B6210
	15 — 800 hp	51B7693
	60 — 1750 hp	05B7542
Totally-enclosed fan-cooled (End-shield bearing)	½ — 100 hp	51B7225
	40 — 800 hp	51B7149
	125 — 3000 hp	05B7150
Two-pole — 900 hp and larger		05B7550
Large vertical		05B7629
Large pedestal-bearing		05B7771
Totally-enclosed water-cooled		05B7682
Weather-protected, for outdoor use		05R7874

These three 1500-hp, 3580-rpm boiler feed pump motors are the first of three such sets due for installation at Cincinnati Gas & Electric's Walter C. Beckjord station.

Large or small, the auxiliary drive motors for all three generating units at this new station will be Allis-Chalmers designed and built. The fact is, Cincinnati Gas & Electric learned thirty years ago that you can depend on A-C for reliable power plant auxiliary drives.

You can get auxiliary drive motors engineered to fit your requirements by calling in your A-C representative early in the planning stages. For design details, ask for the bulletins listed at the left. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4058

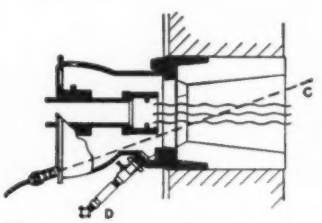
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

BOOM!

How fireye works

to give you complete flame failure protection...



1 — To eliminate dangerous gases in combustion chamber (from leaking shut off valve during down time of burner,) FIREYE purges chamber (C) before igniting pilot (D).

COVERING THE U.S.A.— and Canada, factory-trained field engineers provide "know how" of flame failure safeguarding with FIREYE.

"The day it rained biscuits" in Ames*, Massachusetts

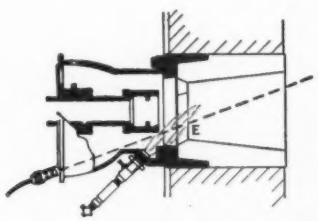
This Yankee classic was coined by a resident to describe the violence of the burner flame failure explosion in the local bakery. Damage of $130,000, and a year of non-production resulted from the hazard that exists in any building with unprotected fuel burning equipment.

**Actual town name upon request*

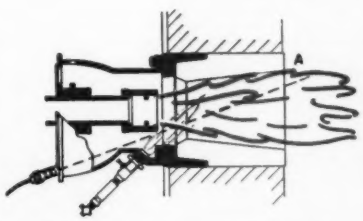
IN ANY PLANT not fully protected — even yours — an explosion can happen if the flame goes out in a fuel burner. Fuel continuing to pour in forms an explosive mixture in seconds . . . to be reignited explosively by the hot firebrick.

Partial protection, from safeguards that require more than a minute for response, can be as ineffective as *no* protection from this hazard. That is the reason insurance companies recommend the kind of protection given by FIREYE. They fully approve the FIREYE SYSTEM . . . the only complete and instantaneous flame failure safeguard controls for all types of fuels. An electronic "eye" works with the speed of light when a burner flame goes out, to eliminate all hazard and effect reignition automatically and safely.

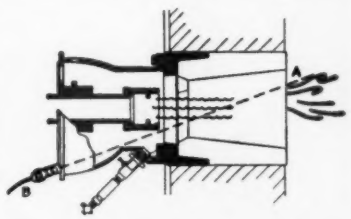
Over 10,000 installations prove FIREYE has no equal for reliability and effectiveness. It can be applied to any type of burner — oil, gas, coal — generally "overnight", and for only a few hundred dollars.



2 — Because pilot flame can fail to light off due to fouled electric ignitors, no fuel, or poor fuel-air mix, FIREYE proves pilot flame (E) is proper before turning on main fuel valve.



3 — If main flame (A) is not sighted at end of safe trial ignition period (due to no main fuel, poor fuel-air ratio or draft) FIREYE shuts down burner.



4 — If main flame (A) fails due to poor fuel-air ratio or draft, or fuel interruption, FIREYE shuts down burner in 2 to 4 seconds to prevent explosion of unburned gases.

fireye

PLAY SAFE! SEND NOW!

This could be the most important booklet you ever read

Why take chances? Even with modern power, processing or heating equipment, the chances are 4-to-1 you do not have complete flame failure safeguards. Send for this new "primer" on flame failure explosion hazards. It tells how you can simply check the protection you now have, and what you need.

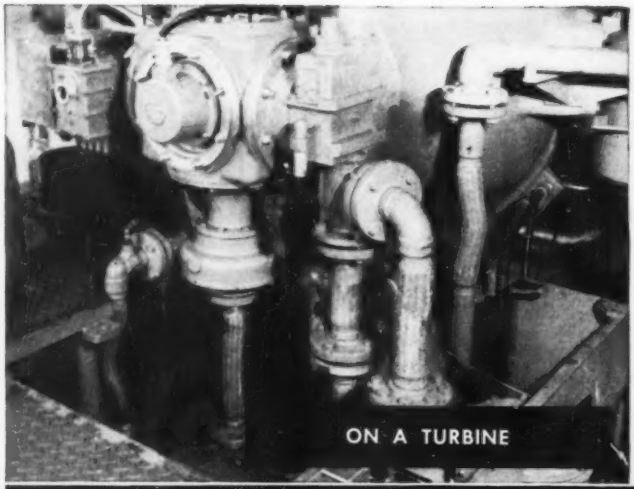
COMBUSTION CONTROL CORP., Dept. PB 6
718 Beacon St., Boston, Mass.

Send me your free booklet "Guarding Your Plant Against Flame Failure Explosions".

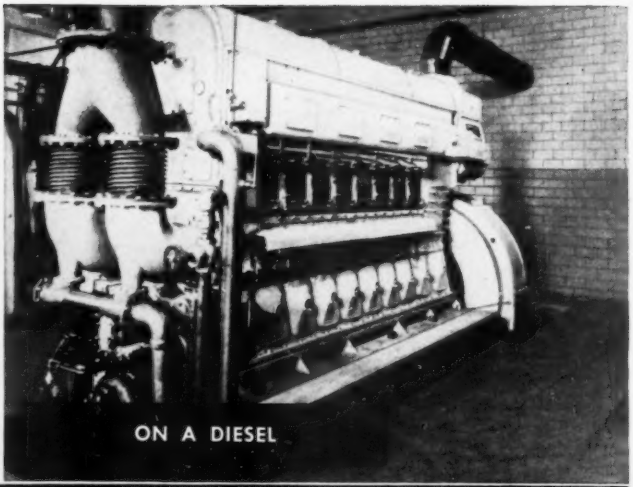
Name.....*(Title)*.....

Firm.....

Address.....



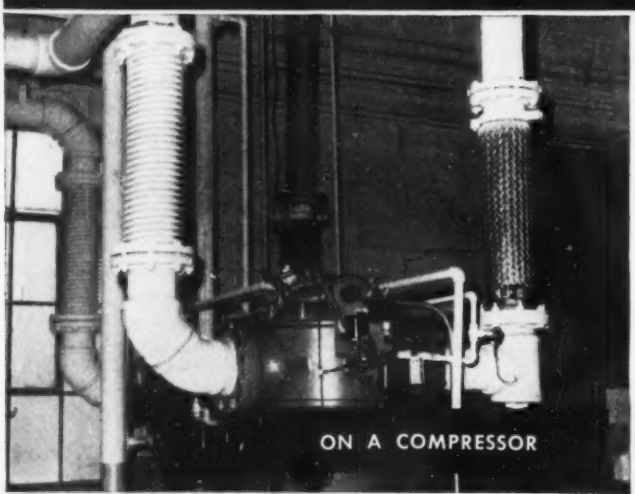
ON A TURBINE



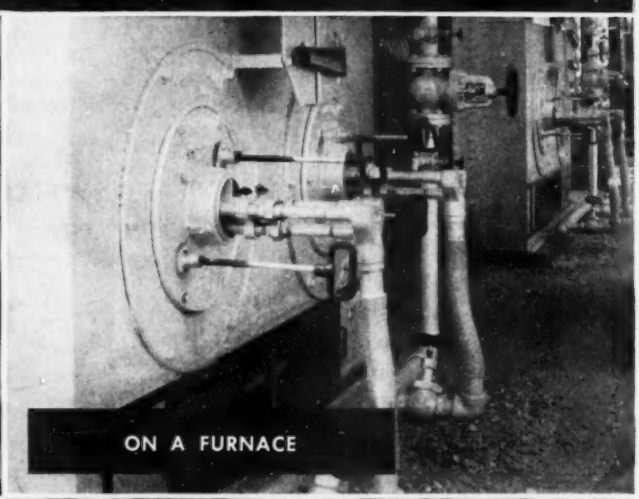
ON A DIESEL

Wherever vibration, flexation, misalignment or

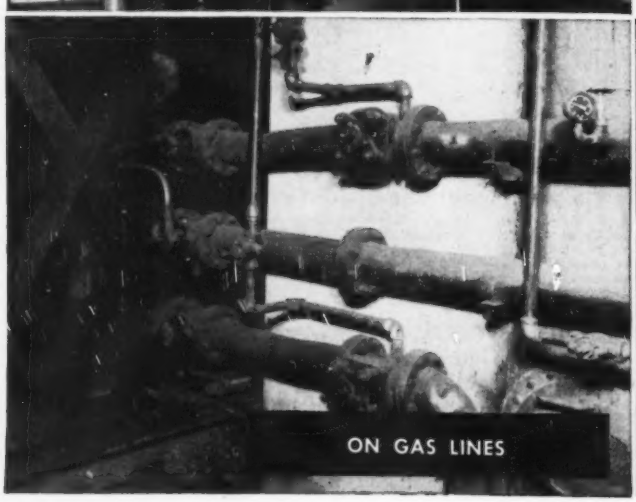
make the connection with CMH



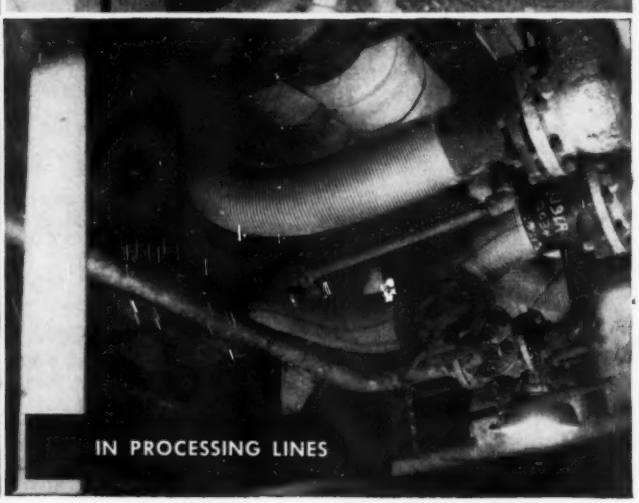
ON A COMPRESSOR



ON A FURNACE



ON GAS LINES



IN PROCESSING LINES

■ CMH Flexible Metal Hose, properly used, can save many times its cost by eliminating piping failure due to motion and fatigue stress . . . by simplifying installation . . . by reducing the number of fittings required . . . by minimizing downtime required for piping maintenance. In CMH flexible metal hose, you get the rugged durability of metal combined with a high degree of flexibility. You get a non-aging, non-contaminating, non-collapsible assembly with no joints to pack, assuring a long, dependable, maintenance-free life.

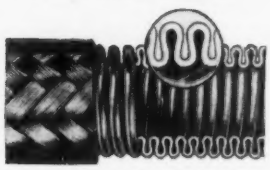
In the CMH complete line of flexible metal hose products there is the exact type to meet your needs. Pressures from vacuum to 24,000 psi (burst) can be accommodated. A wide variety of metals is offered, too, to provide hose types which are corrosion resistant, fire resistant and capable of handling extremely searching liquids and gases.

Whenever, a connection problem involves vibration, flexation, misalignment or expansion and contraction, think first of CMH flexible metal hose for an economical, dependable and safe solution. Your Flexonics distributor will be pleased to go over your requirements with you. Look for his name in the classified pages of your telephone directory or write and we will send it.

expansion and contraction is a problem.....

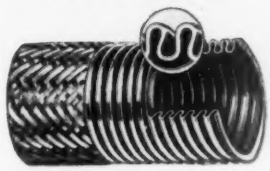
FLEXIBLE METAL HOSE

REX-WELD HOSE



CMH REX-WELD corrugated steel hose in sizes from 3/16" through 24" I.D. for burst pressures to 12,000 psi, temperatures to 1000°F. Also available in bronze.

REX-FLEX HOSE



CMH REX-FLEX corrugated stainless steel hose in sizes from 5/16" through 2" I.D. for burst pressures to 24,000 psi, temperatures to 1600°F.

REX-TUBE TYPE RT-6

CMH REX-TUBE Type RT-6 fully interlocked flexible tubing in galvanized steel, aluminum, brass and other metals; sizes ⅓" through 8" I.D.

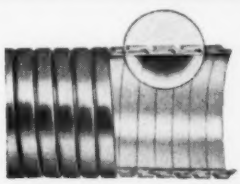
REX-TUBE TYPE RT-15

CMH REX-TUBE Type RT-15 fully interlocked steel or bronze utility hose in sizes from ½" to 12" I.D. for pressures to 750 psi. (constant), temperatures to 600°F.

REX-TUBE TYPE RT-20

CMH REX-TUBE Type RT-20 steel or bronze ball bearing type utility hose in sizes from 3/16" through 1¼" I.D. for low to moderate pressures and temperatures.

ABRASION RESISTANT HOSE



CMH "Abrasion Resistant" hose Type AR-1, fully interlocked with strip inner liner for handling grain, forage, ashes and other dry solids, 1½" to 12" I.D.

Catalog 130 gives specifications and application data on CMH flexible metal hose. Write for your copy or see Flexonics catalogs in Sweet's, Chemical Engineering Catalog or The Refinery Catalog.

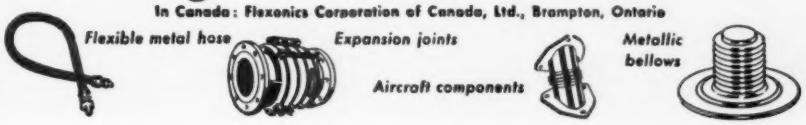
Flexon identifies CMH products that have served industry for over 50 years.

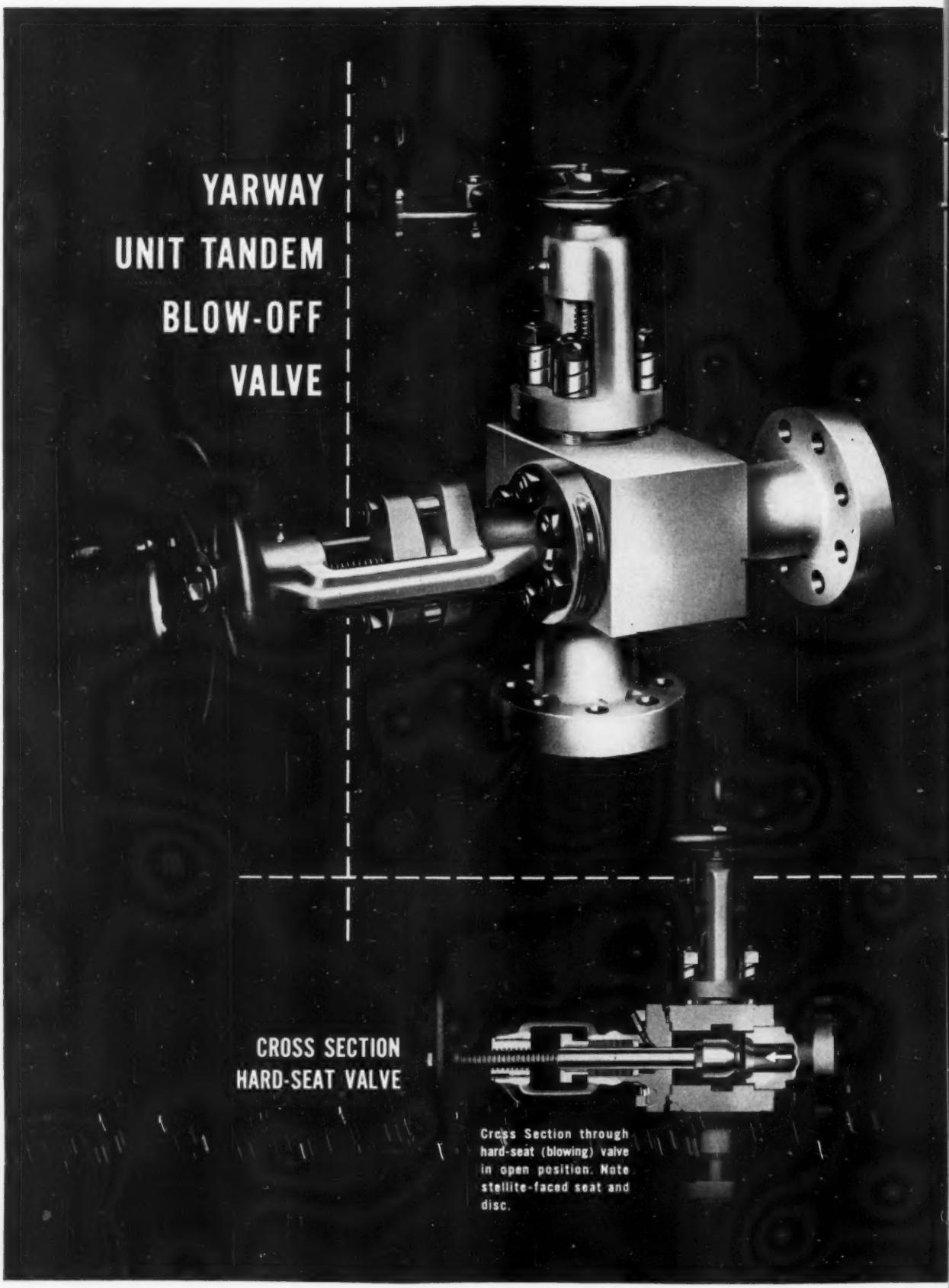
CMH

CHICAGO METAL HOSE Division

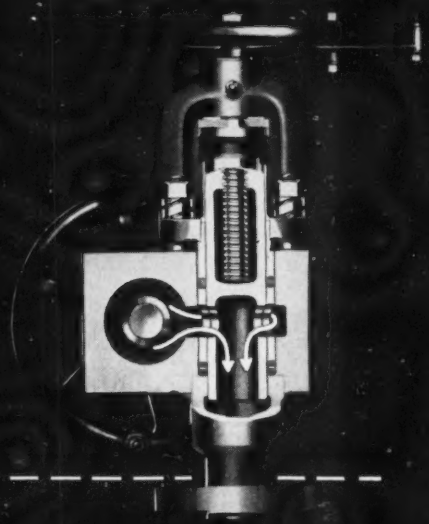
Flexonics Corporation 1301 South Third Avenue, Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario




YARWAY
UNIT TANDEM
BLOW-OFF
VALVE
CROSS SECTION
HARD-SEAT VALVE
Cross Section through hard-seat (blowing) valve in open position. Note stellite-faced seat and disc.

CROSS SECTION
SEATLESS VALVE



Cross Section through seatless (sealing) valve in open position. (On pressures over 1500 psi two hard seat valves are recommended.)

RUGGEDNESS

. . . WHERE YOU NEED IT

A one-piece forged steel block serves as the common body for both valves in Yarway Unit Tandem Blow-Off Valves.

You get rugged strength where you need it . . . added protection for your high pressure boilers.

Whether in times of emergency, normal blowdown service, or acid washing, this high safety factor is a source of satisfaction to boiler plant operators.

Yarway Unit Tandems combine all advancements of modern metallurgy with experienced design and skilled workmanship. The result—DEPENDABLE PROTECTION.

POSITIVE ACTION

. . . WHEN YOU NEED IT

When putting high pressure boilers on the line, or in times of emergency, you need positive action at the blow-off valves.

With Yarways you have it.

Both the hard seat-seatless combinations and the hard seat-hard seat combinations provide positive opening and closing with drop-tight shut-off. Open yokes permit visual indication of the disc position in the hard seat valve and of the plunger in the seatless valve.

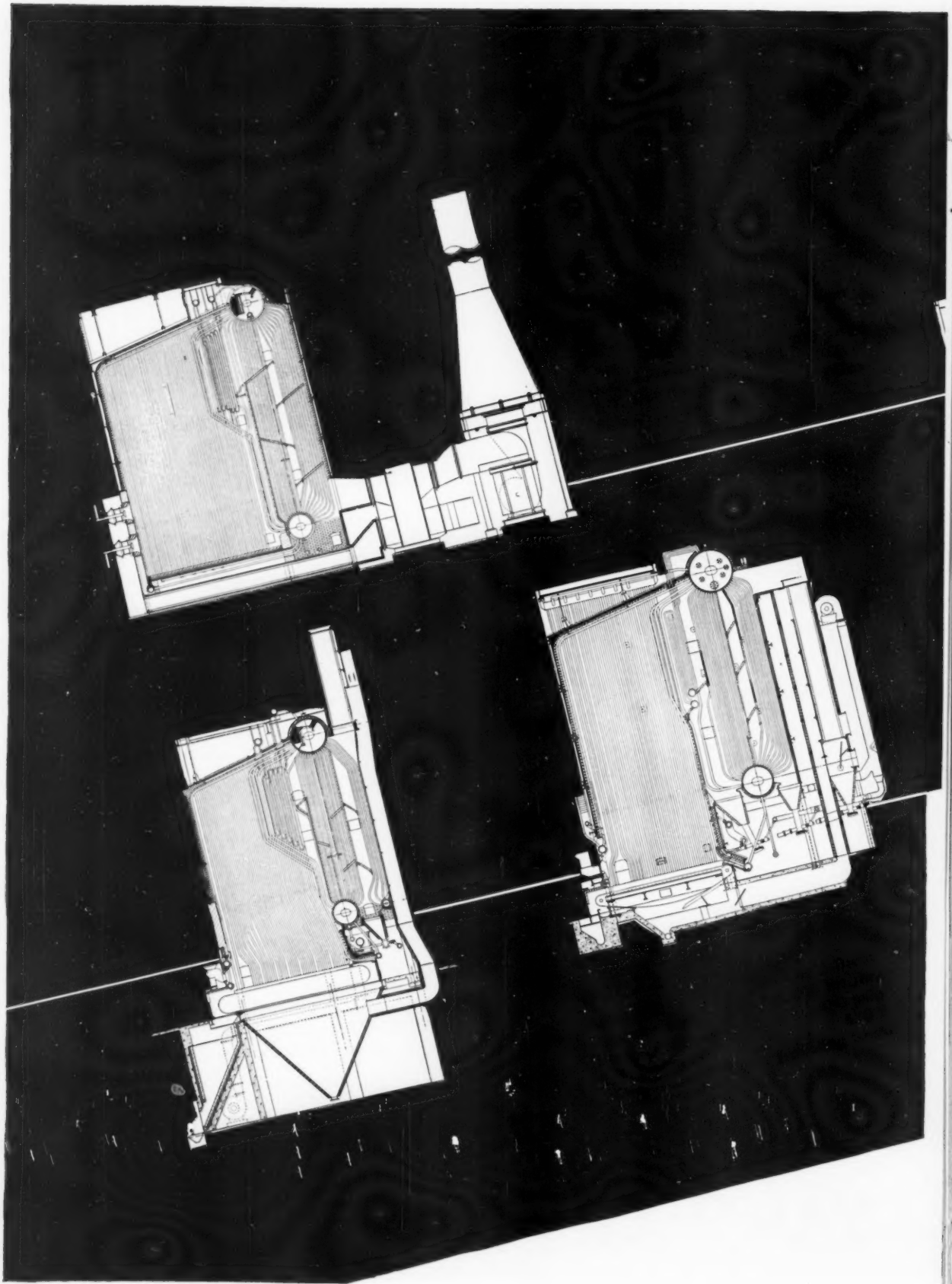
These are some of the reasons why *more than 4 out of every 5 high pressure plants in the United States are Yarway-equipped . . . and* among boiler plants of all pressures, *more than 16,000 are Yarway-equipped.*

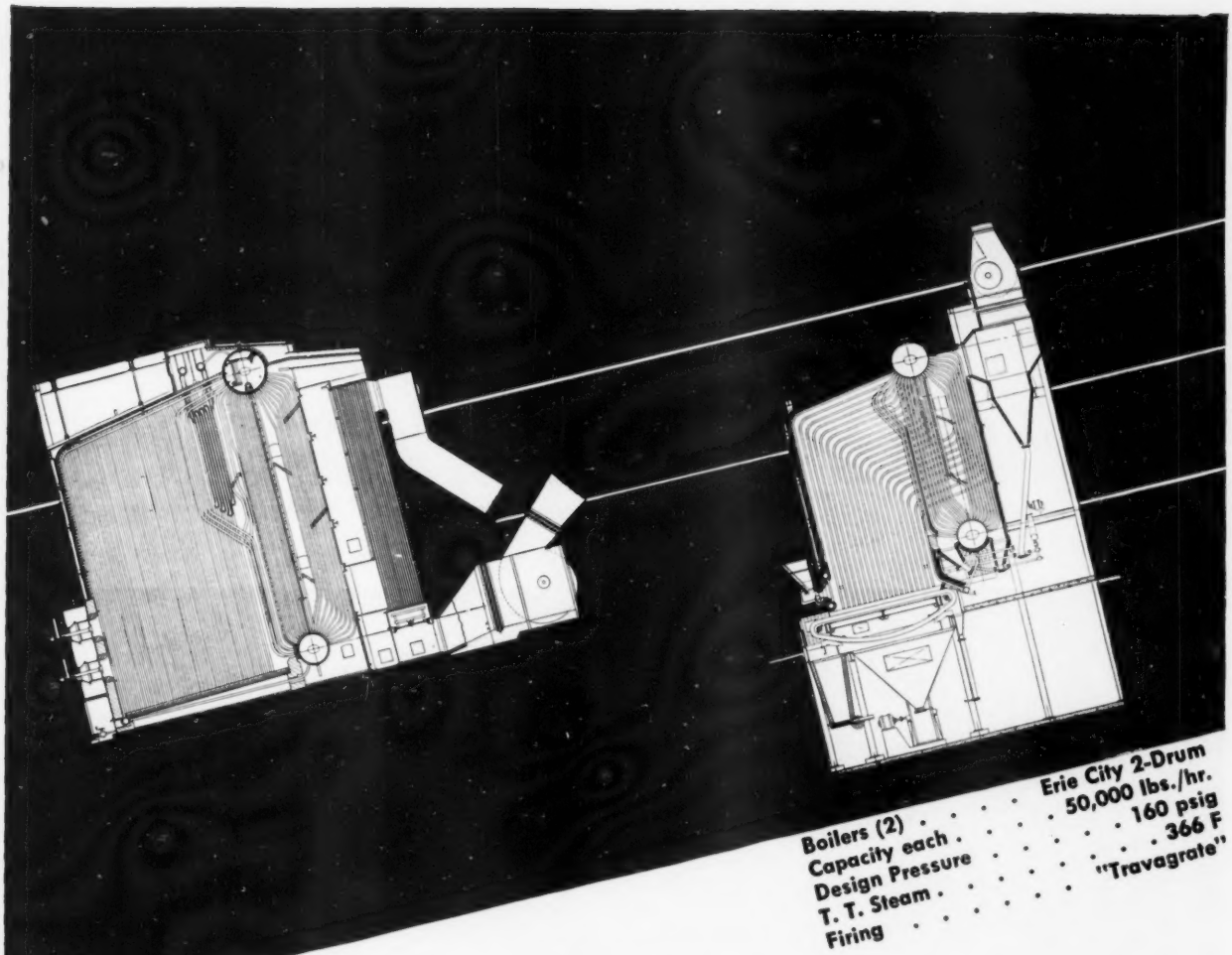
Write for your free copy of Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

blow-off valves



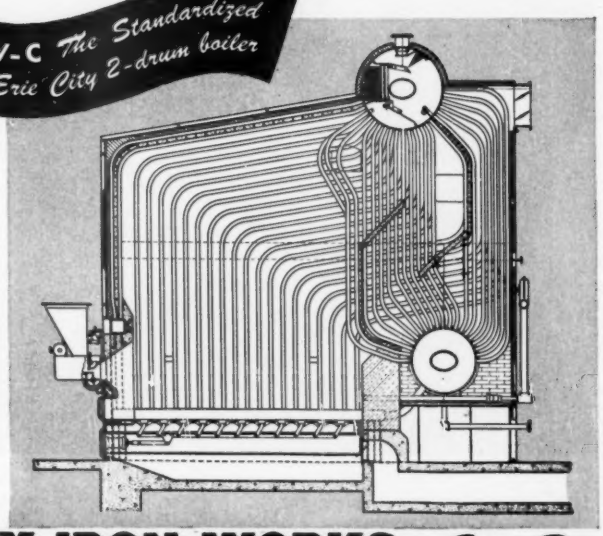


Boilers (2)	Erie City 2-Drum
Capacity each	50,000 lbs./hr.
Design Pressure	160 psig
T. T. Steam	366 F
Firing	"Travagrate"

you can depend on Erie City for sound engineering

Hundreds of Erie City 2-Drum Boilers have been installed since 1909. Some recent and typical installations are shown here to indicate that we have set the pace in modern practice. Erie City custom built 2-drum steam generators are available to meet special conditions. For normal steam requirements we have developed the VC two drum line in standard types and many capacities for any firing method. Ask for Bulletin VC-6. Send your steam problem —our engineers are at your service.

V-C The Standardized Erie City 2-drum boiler



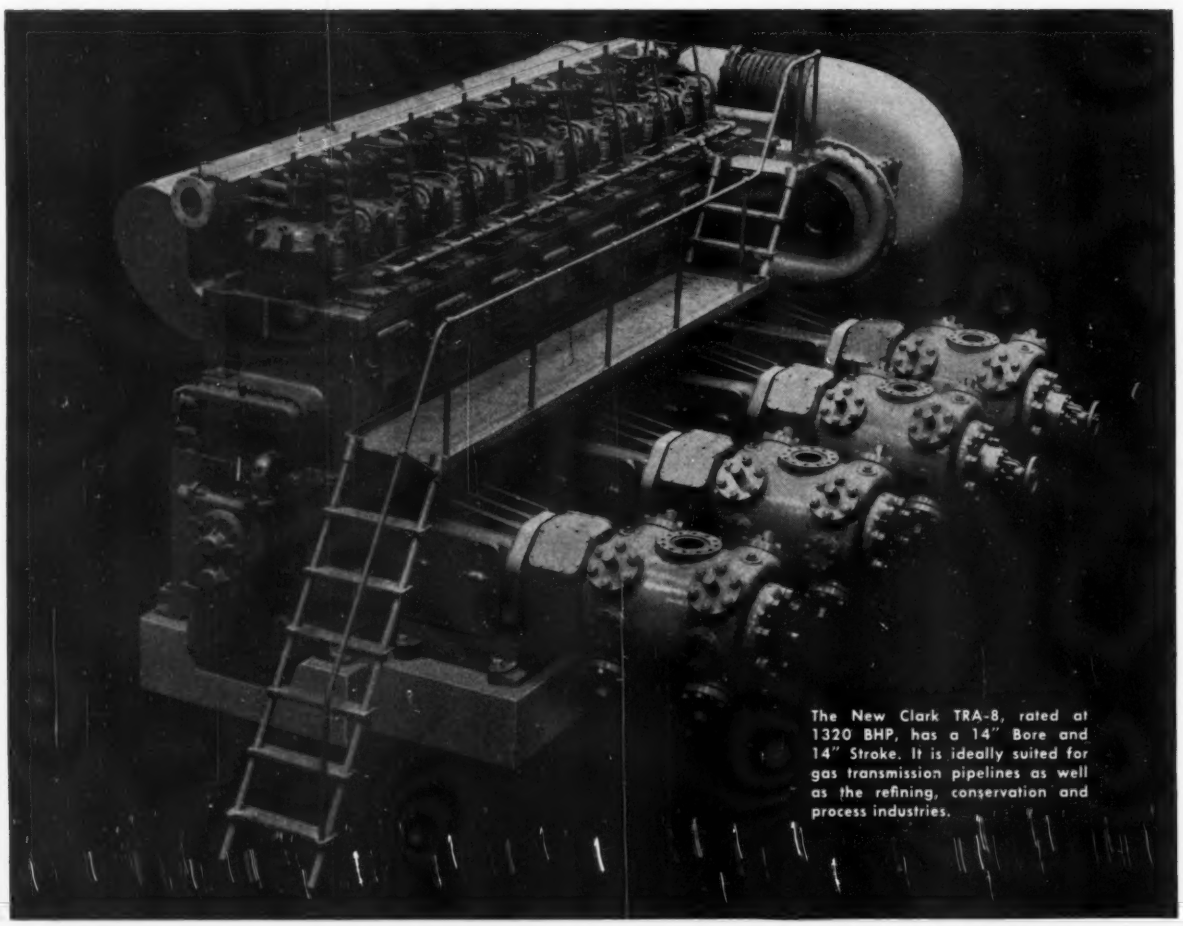
ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS

UNDERFEED AND SPREADER STOKERS • PULVERIZERS

ITS HERE! a

The NEW Clark 2-Cycle



The New Clark TRA-8, rated at 1320 BHP, has a 14" Bore and 14" Stroke. It is ideally suited for gas transmission pipelines as well as the refining, conservation and process industries.

Clark Continues to Set the Pace in Compressor Progress

revolutionary compressor development!

Turbo-Charged "Right Angle"

It's here — after seven years of intensive development. Clark revolutionizes compressor design with the first 2-Cycle Turbo-Charged Gas Engine Driven Compressor . . . the TRA. Another Clark first! A precedent-shattering development that makes possible —

50% MORE POWER
Developing 1320 bhp, the TRA-8 delivers 50% more power than any comparable compressor, with *no* encroachment on overload carrying ability.

SHARPLY REDUCED FUEL CONSUMPTION
The TRA is conservatively rated *and guaranteed* to burn substantially less fuel than *any* gas engine driven compressor now built.

25% LESS COOLING WATER LOAD
(Including scavenging air intercooler load.) Vast amounts of waste heat are recovered from the exhaust gases by the Clark Turbo-Charger and are converted to useful work.

FLAT FUEL CONSUMPTION CURVE
Fuel consumption remains practically constant over a wide range of load conditions.

QUIET
Energy goes into power, rather than noise. Much quieter than a conventional gas engine driven compressor. No exhaust pulsations.

UNPRECEDENTED RUGGEDNESS
Tremendous stamina, unapproached by any other compressor design. Conservative BMEP rating.

COMPACT IN-LINE DESIGN
Very economical of floorspace, foundations and building requirements, yet highly accessible.

●

The Clark TLA, with 17" bore and 19" stroke, is also available when units of even greater horsepower than the TRA are required. For complete engineering details — the facts behind this revolutionary compressor development — see your nearest Clark representative and write for Bulletin 130.

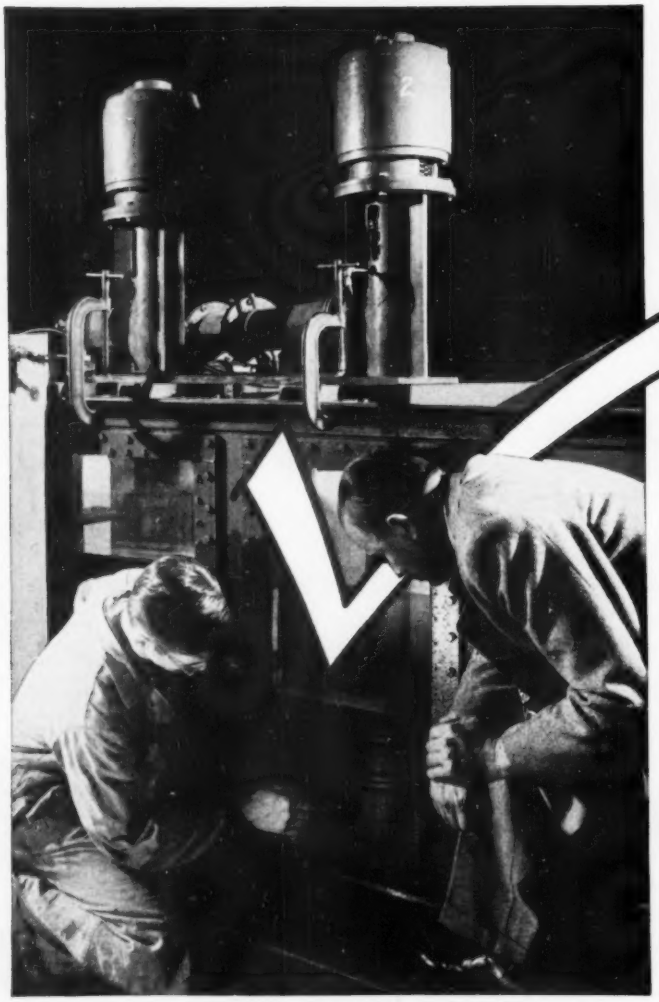
CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

CLARK compressors

© 1953, Clark Bros. Co., Division of Dresser Operations, Inc.



PUMP Laboratory

Check Suction Bay and Pump Performance in Advance

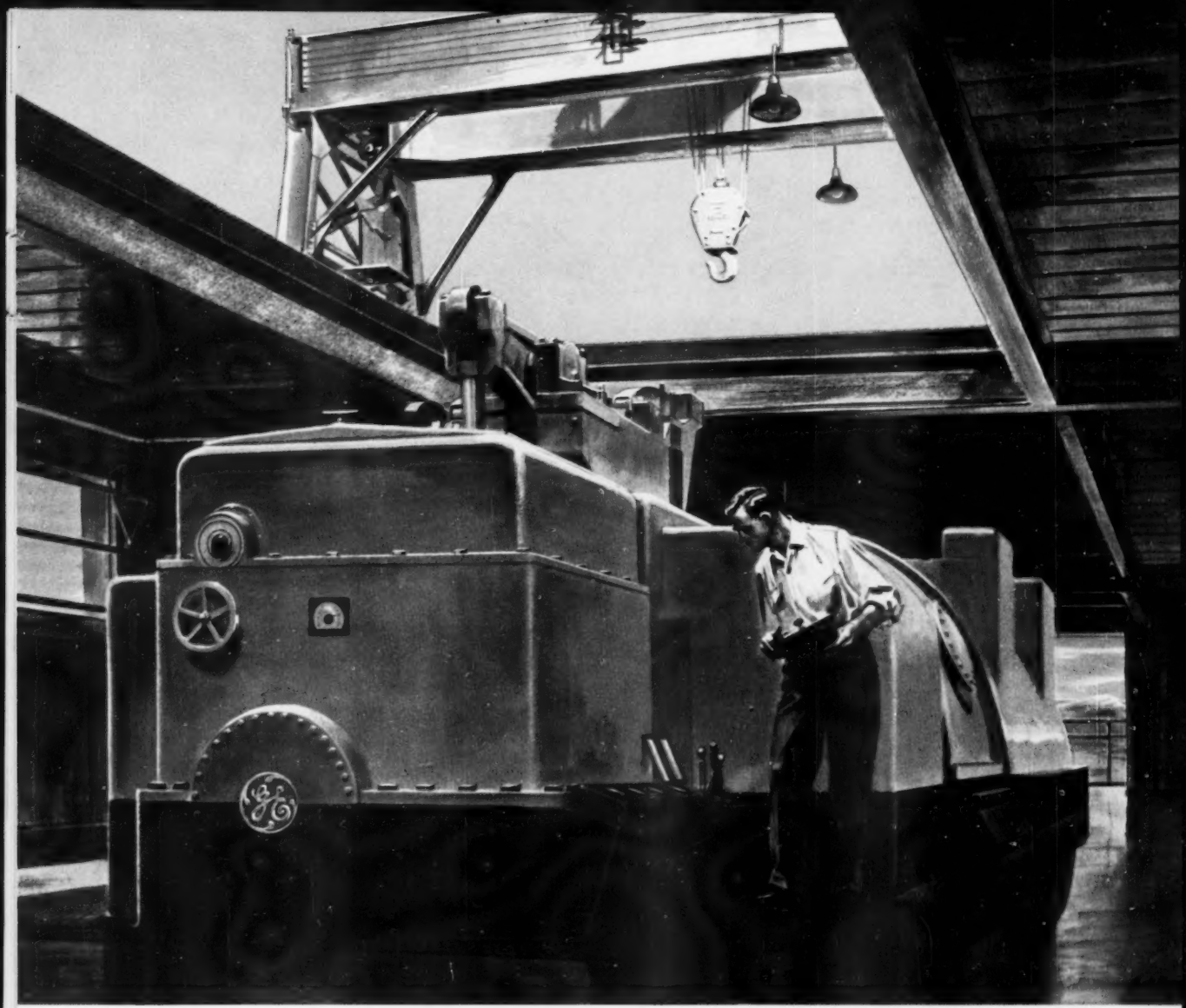
Use this Allis-Chalmers pump laboratory to duplicate your suction bay design and operating conditions.

WHY CHANCE EXPENSIVE BUILDING ALTERATIONS when you can be sure of suction bay and circulating pump performance in advance. In the Allis-Chalmers pump laboratory, an exact scale model of your suction bay can be built. Then you observe the effects of different foundation arrangements . . . can check efficiencies under partial load . . . test the ultimate capacity of your design in case of expansion . . . see what happens under different water conditions. This way you can be sure that you have the right design, down to the last detail.

Available to Power Plant Operators and Consulting Engineers

The Allis-Chalmers pump laboratory is located at the West Allis, Wisconsin, Works and is available for use for all power plant operators and consulting engineers with large pump and water supply problems. For details of the services available, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3973

ALLIS-CHALMERS



STEARNS-ROGERS MANUFACTURING CO., ENGINEERS AND CONSTRUCTORS

At Public Service of New Mexico's New Person Station

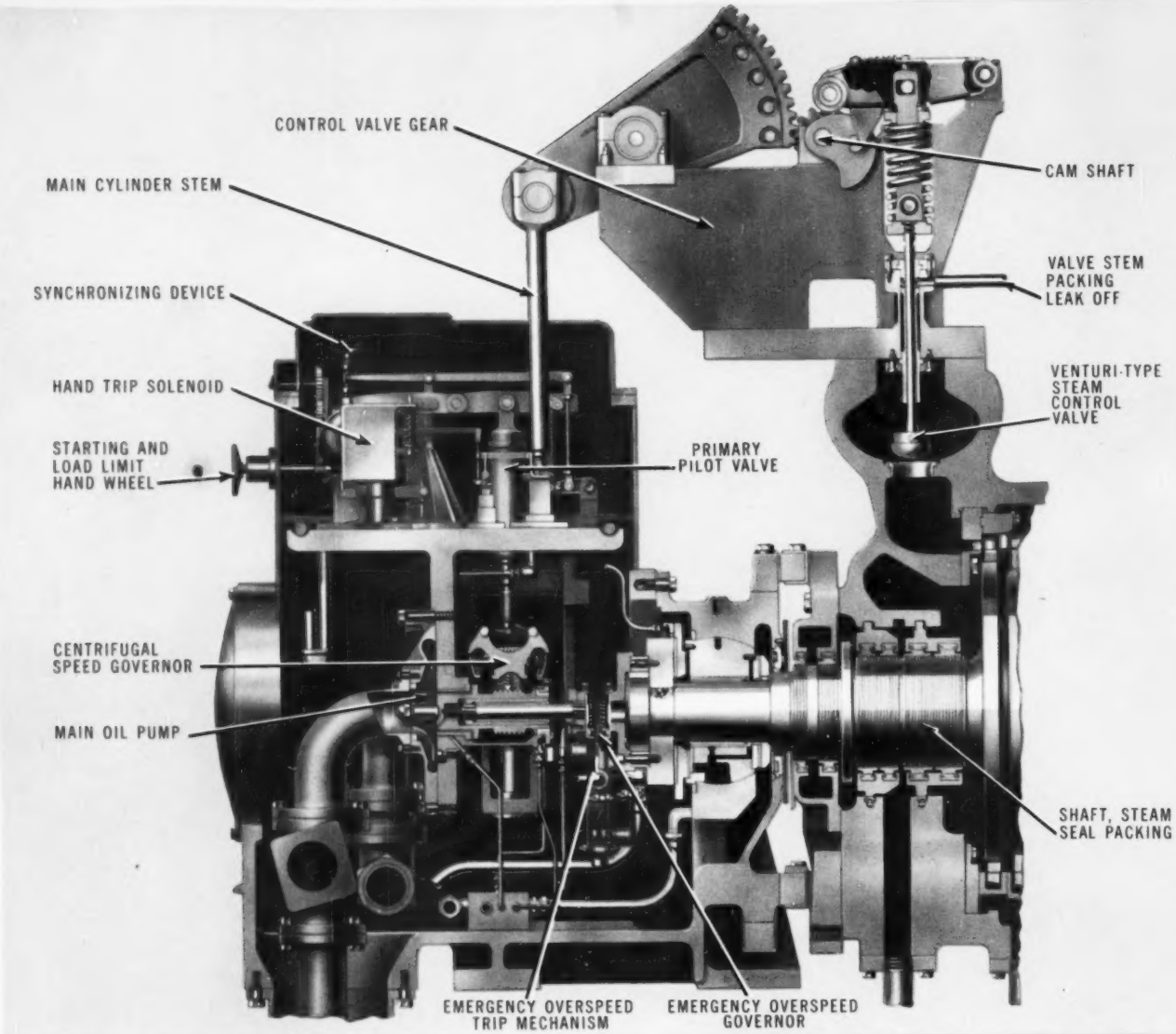
GENERAL ELECTRIC TURBINE-GENERATOR PROVES REMARKABLE STABILITY OF MECHANICAL GOVERNING

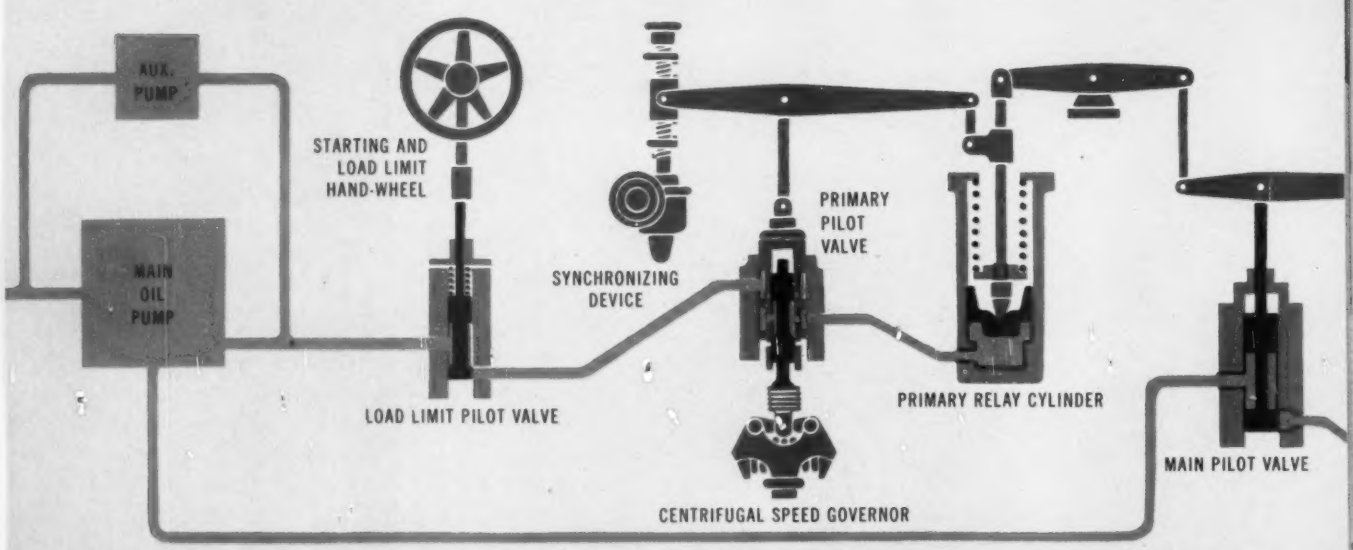
HEART OF THE REGULATING SYSTEM for the Person Station turbine is this small mechanical governor which controls pressure oil to operate the steam inlet valves.

To combine operating convenience with maximum accuracy and dependability, General Electric builds the same basic mechanical governing system into all turbine-generators from 2000 to 200,000 kw. On units like the new 20,000 kw machine at the Person Station of the Public Service Company of New Mexico, located at Albuquerque, turbine speed is actually held within 0.04% of initial setting.

GENERAL ELECTRIC

FOR DETAILS TURN TO FOLLOWING PAGES...





HOW THE TURBINE GOVERNOR OPERATES. During starting, the operator brings the turbine up to rated speed by turning the *handwheel*. The *main pump* supplies oil to the system through the *load limit pilot valve*. If the turbine tends to slow down with increased load, the *centrifugal speed governor*, gear driven from the turbine shaft, opens wider the *primary pilot valve*. This valve meters oil to the *primary relay cylinder* which simultaneously opens wider the *main pilot valve* through a mechanical linkage and restores the primary pilot valve bushing to a new position. Pressure is increased in the *main cylinder* which lifts the *valve gear* and allows more steam to enter. When the main cylinder is lifted, it restores

Mechanical Governing System Makes Rapid Response to Load Changes

"Easy to Start... Simple to Adjust" *Report Operators at New Person Station*

To keep pace with power demands which have nearly doubled in the last four years, Public Service of New Mexico recently put into operation its new semi-outdoor Person Station at Albuquerque. The first turbine on the line, a duplicate of which is now on order, is a General Electric 20,000 kw unit, governed by a standard G-E mechanical-hydraulic system.

Response to load changes is fast...so fast that the turbine speed will be held below trip speed even though full load is dropped from the generator instantaneously. Because the governor does no actual work other than to position a relay cylinder, accuracy is high. Safety and dependability are increased by the system's insensitivity to dirt or changes in oil viscosity.

Station operators find the governor ideal from their point of view. "The turbine is easy to start because the handwheel requires almost no pressure," reports one. "It's simple to adjust the settings—there's no lagging to pull off to reach the governing mechanism."

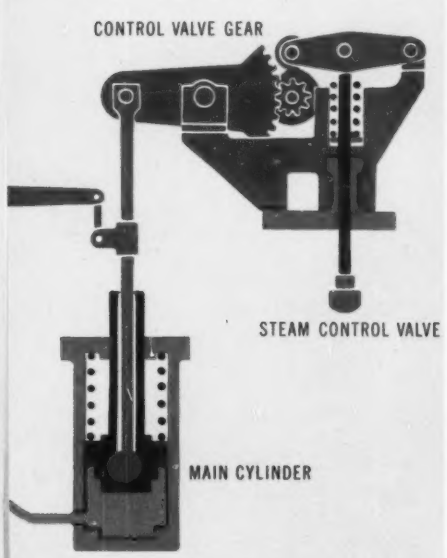
Despite its basic simplicity, the governor is flexible enough to meet a variety of system requirements. For instance, the turbine will "ride through" emergency conditions when operating personnel need to attend other equipment in the station.

Governing refinements are a major G-E contribution to power station efficiency—an additional assurance that General Electric offers more turbine for the utility's investment dollar.

Leader in Turbine Generator Progress

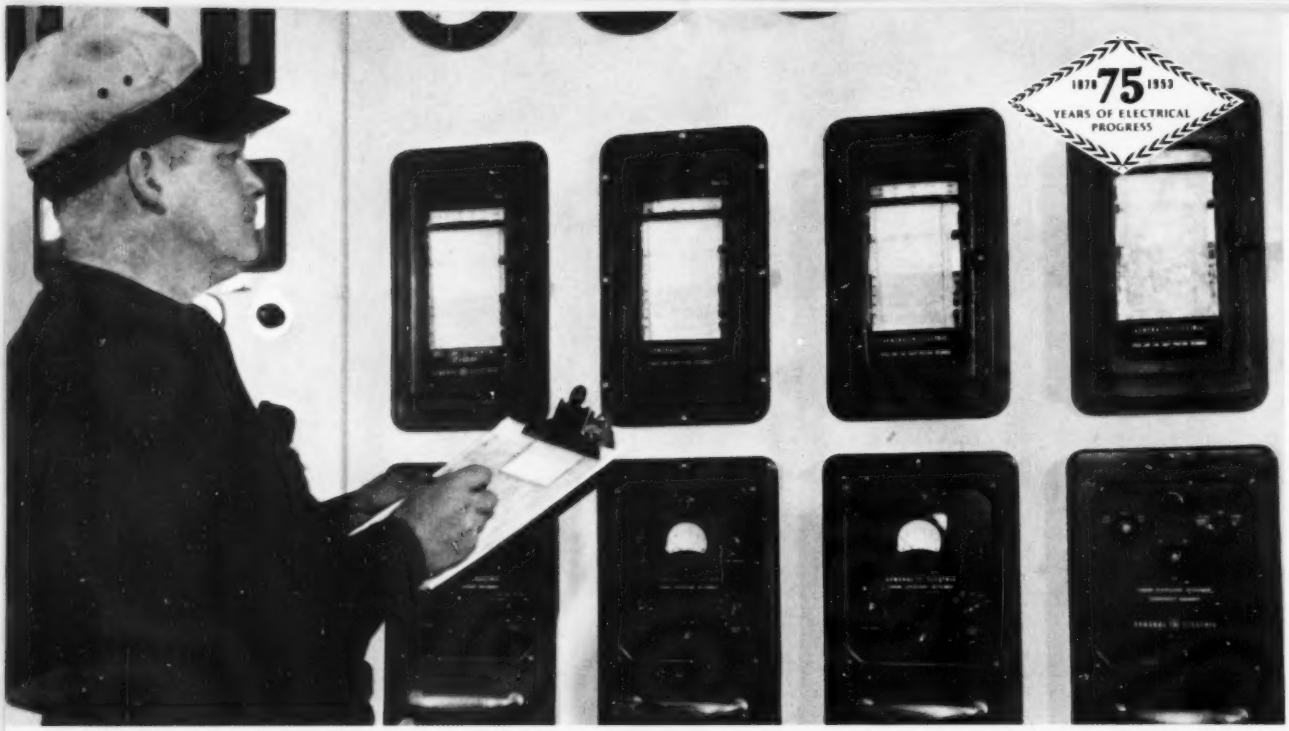
GENERAL ELECTRIC

CROSS SECTION OF FRONT END of 20,000 kw General Electric turbine, showing mechanical-hydraulic governing system.



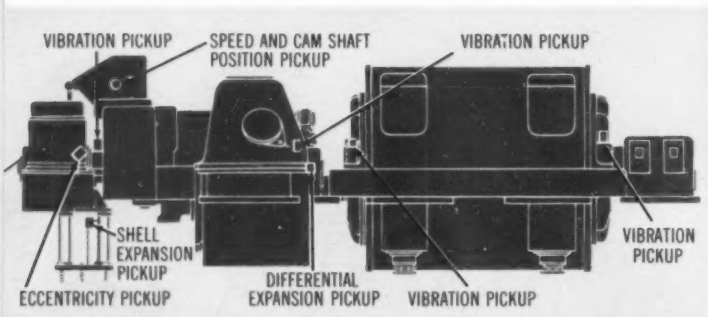
the main pilot valve to its controlling position and the system is in equilibrium at the new load. If the turbine tends to speed up on decreased load, the system operates in reverse.

GOVERNOR FEATURES are discussed by J. M. Baker, Governor and Control Engineer; A. D. Somes, Manager of Turbine Engineering; and L. D. Whitescarver, Manager of Marketing in G.E.'s Medium Steam Turbine, Generator & Gear Department.



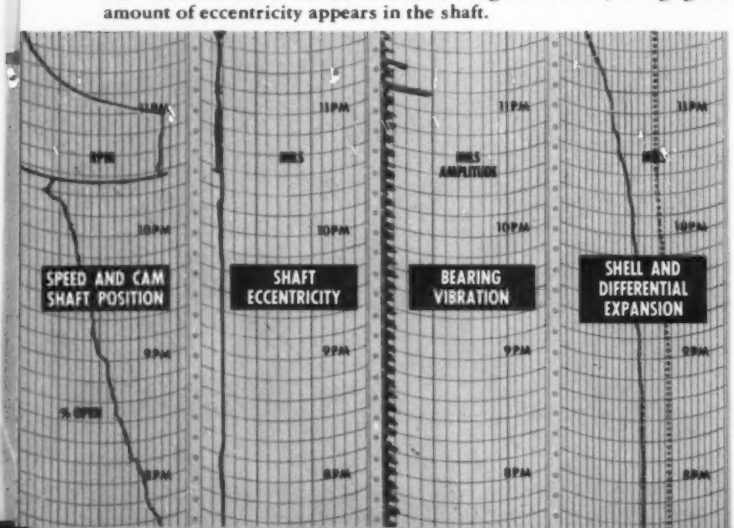
1878 75 1953 YEARS OF ELECTRICAL PROGRESS

SUPERVISORY INSTRUMENT PANEL houses all recorders and electronic power units connected to pickups on the turbine-generator.



LOCATION OF PICKUPS for supervisory instruments is shown on a typical 20,000 kw General Electric turbine-generator.

STRIP CHART RECORDS show a typical turbine's operation during reduction of load and shut down. From 7:30 p.m. to 9:45 p.m. while load is being decreased, shaft eccentricity and bearing vibration remain normal. Camshaft position recorder shows load dropping to about one-third of rating, and the differential expansion recorder indicates a slight decrease in forward clearance. When unit goes off the line about 10:30, speed indicator shows full speed until turbine is tripped out at 11:00. While the turbine is running at no load, a negligible amount of eccentricity appears in the shaft.



Supervisory Instruments Supplement Turbine Governing Accuracy

To provide accurate records of operation, as well as added protection for equipment, many electric utilities are now installing supervisory instruments with turbine-generators. This type of instrumentation is especially important in augmenting regular turbine governing on systems with centralized controls at remote points from the power generating equipment, or in stations following a practice of quick-starting their machines.

Speed and camshaft position recorders report changes in load as well as recording speed on start-up and shut-down. They also contribute to quick analysis of system disturbances which cause generator line breakers to open.

Shell and differential expansion recording equipment provide an index of operating clearances between rotating and stationary elements of the turbine-generator. Vibration and shaft eccentricity recorders detect immediately any hazards to smooth operation of the machine.

If you would like more information on turbine supervisory instruments, contact your G-E sales engineer. He will be glad to show you how they can fit into your planned system control. General Electric Company, Schenectady 5, N. Y. 256-1

You can put your confidence in—

GENERAL ELECTRIC

Superior Heat Exchangers

are engineered to present day advances in power plant, chemical process, petroleum refining and industrial applications.

Superior Combustion Industries, Inc., designs, fabricates in their own plant, and guarantees the performance of heat exchangers for all applications . . . selecting proper details to match operating conditions of pressure, temperature, special materials or pressure drop limitations for every heating, cooling, evaporating or condensing operation.

Our Engineering Department invites your inquiry on any proposed application as a basis for a specific engineering recommendation. Write for catalog 5010.

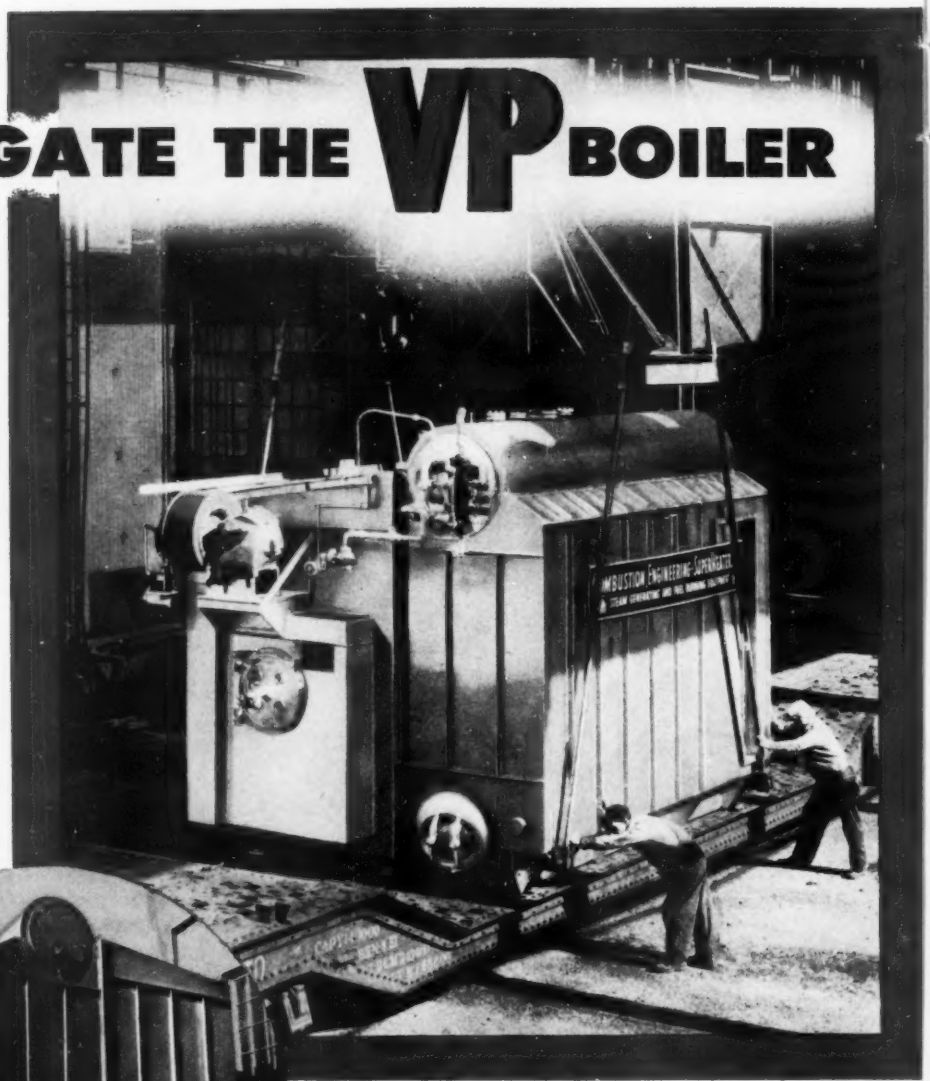
for performance you can **BANK** *on*

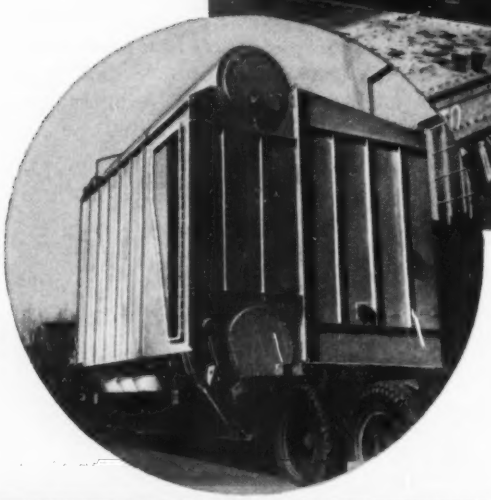
SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS

Don't settle for just

INVESTIGATE THE VP BOILER





VP Boilers are available in capacities from 4,000 to 30,000 lb of steam per hr; pressures to 250 psi. Send for Bulletin VP-102.

COMBUSTION

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

A Package Boiler

...the Package Boiler with EXTRA features

If you're in the market for a Package Boiler, here's the problem you face. There are a number of water-tube, package boilers being offered today. Most of them look pretty much alike. And, in some respects, they *are* alike.

But you're looking for the "best buy" in a package boiler. Therefore your interest lies in points of difference rather than points of similarity. The C-E Package Boiler, Type VP, offers all the better design features of its contemporaries *plus* the following extra features:

1. Fully Water Cooled Furnace — More cooling area per cubic foot of furnace volume than any other boiler of the VP's size and type. In all but the three smallest sizes, the VP Boiler has water-cooled walls on *all six sides* of the furnace — including the burner wall.

2. Larger Lower Drum — The 30-in. diameter lower drum permits a simple, symmetrical tube arrangement . . . provides easy access for washing down or inspection . . . its greater water storage capacity facilitates the handling of fluctuating loads.

3. Centrifugal Fan — This more efficient type of fan operates at lower speed than other types and is quiet in operation. In fact, its average noise level is less than half that of typical high-speed fans used on most package boilers.

4. Simple Baffle Arrangement — Minimum changes in direction of gas flow — no baffle at all in convection bank of larger VP Boilers. This means lower draft loss . . . simplified soot blowing . . . absence of dead pockets, thus, maximum heat pick-up. In the intermediate sizes, a water-cooled baffle assures minimum maintenance.

B-673

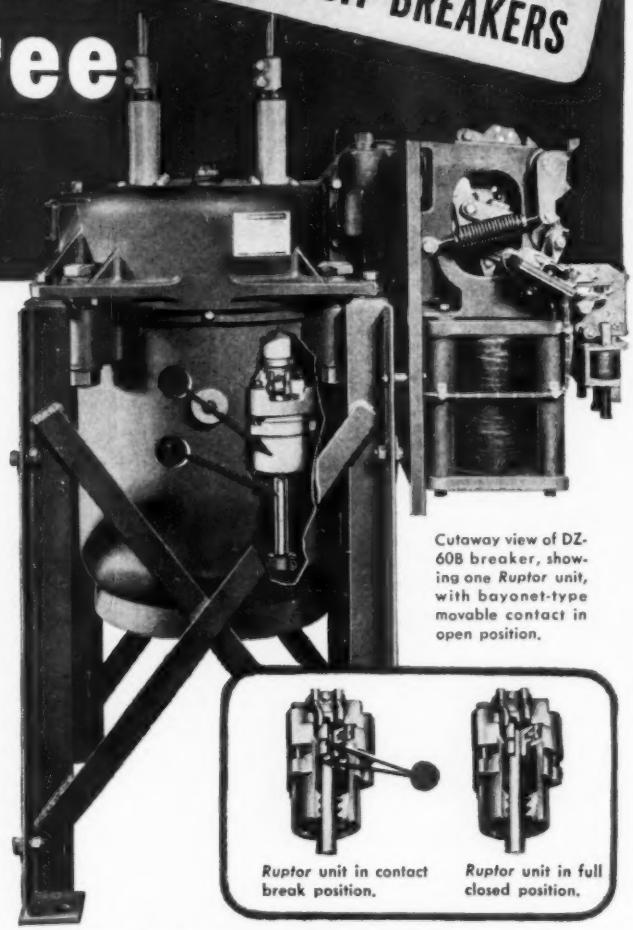
ENGINEERING Inc.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Three Reasons Why

...Years of Trouble-Free Service

ALLIS-CHALMERS *Indoor* OIL CIRCUIT BREAKERS



Cutaway view of DZ-60B breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

One **Few moving parts!**

Bayonet contacts (1) are the only moving parts of the *Ruptor* interrupting device.

Two **Easy inspection!**

Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, one needs only to remove four bolts and cylindrical shell (2).

Three **Self-aligning and Self-cleaning contacts!**

Tulip and bayonet contacts (3) maintain high conductivity without readjustment or cleaning. Arc energy is minimized by efficient interruption within oil-filled *Ruptor* unit. This in turn contributes to long contact life and low oil deterioration.

In addition, a mechanically trip-free solenoid operating mechanism controls contacts of time-proved *Ruptor* interrupting devices. And pole unit mechanism is self-lubricated — completely enclosed — sealed from dust, dirt, corrosion.

In brief, Allis-Chalmers DZ breakers are built to assure years of dependable, trouble-free service.

Allis-Chalmers power circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4057

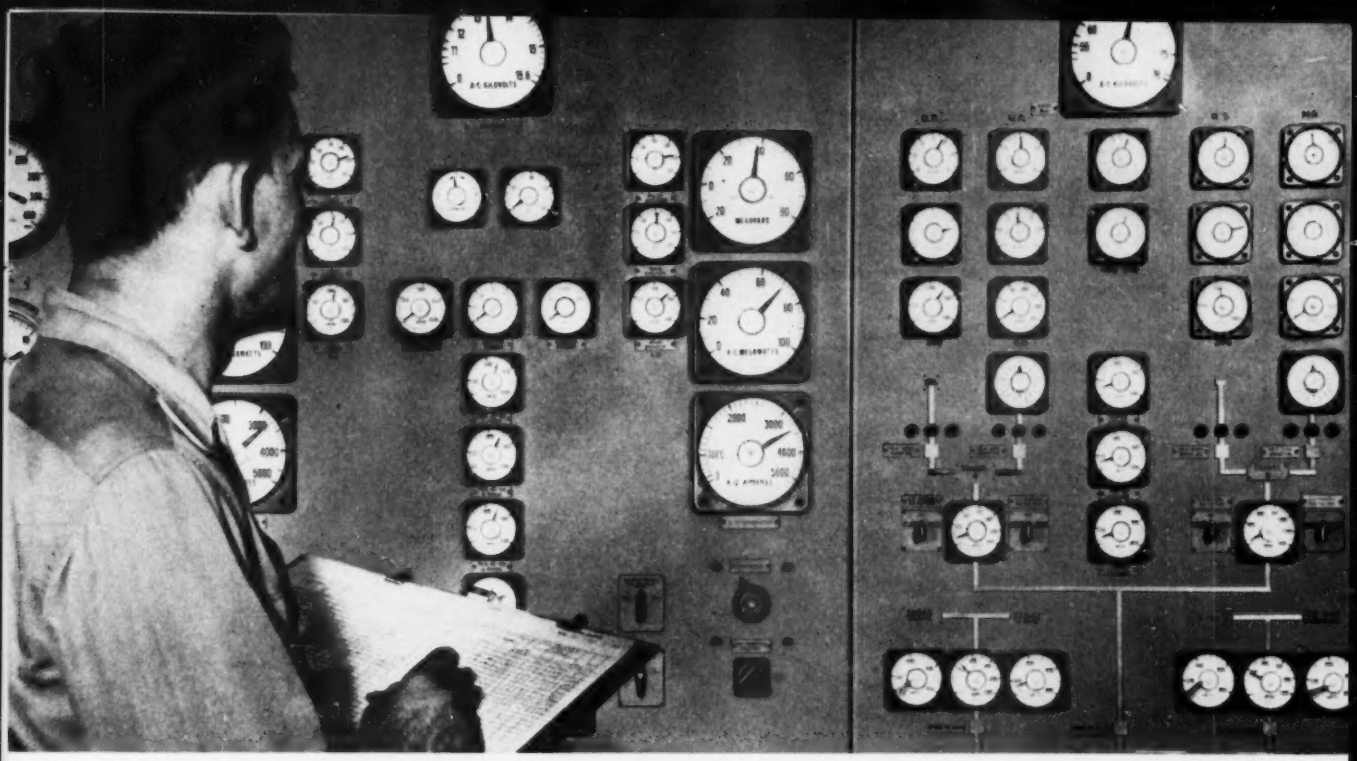
Ruptor is an Allis-Chalmers trademark.

TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179. †Ask for Bulletin 71B6129.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS



G-E SHADOW-PROOF INSTRUMENTS OFFER A LONG SCALE FOR EASY READING, SMALL SIZE FOR ECONOMY OF SPACE.

G-E Switchboard Instruments Designed for Long-distance Reading, Sustained Accuracy

Behind the easily read face of the G-E switchboard instrument is a story of sustained accuracy and space-saving design.

SUSTAINED ACCURACY—±1% of full scale—is assured by building these long-scale instruments around a one-piece magnetic circuit. Since the circuit is thus made a solid mass, the air gap can never vary. Flux always flows evenly to give you accurate readings time after time.

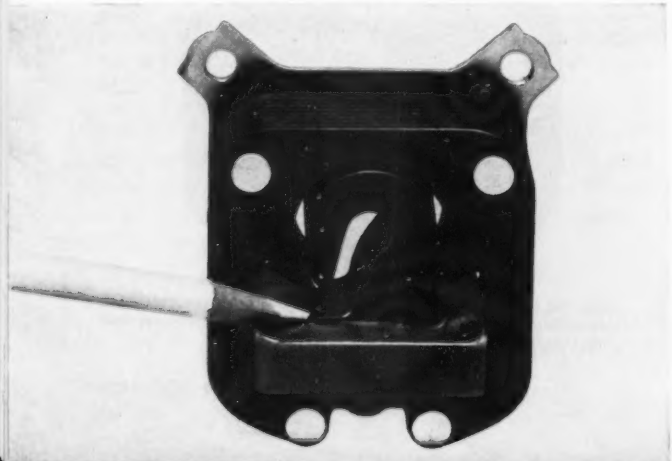
SPACE-SAVING DESIGN of G-E switchboard instruments makes it possible for you to save as much as 33⅓% of valuable switchboard space. A long-scale face only 4¼ inches across is attained because the instrument is designed to operate throughout a 250° arc.

FOR FURTHER INFORMATION, contact your nearest G-E Apparatus Sales representative, or write for bulletin GEC-218 to Section 602-256, General Electric Company, Schenectady 5, N. Y.

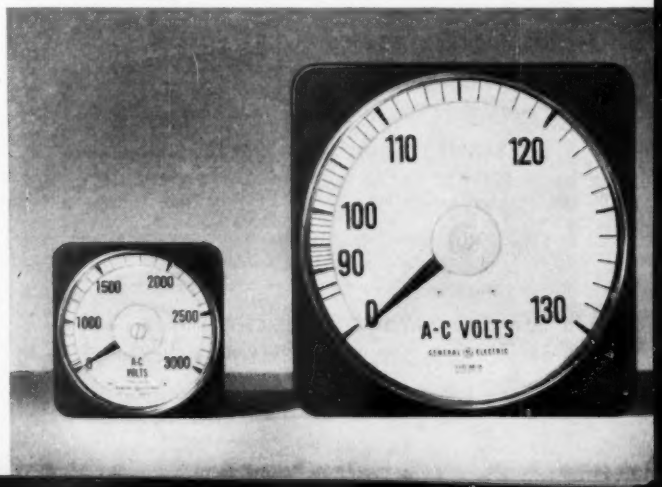
You can put your confidence in—

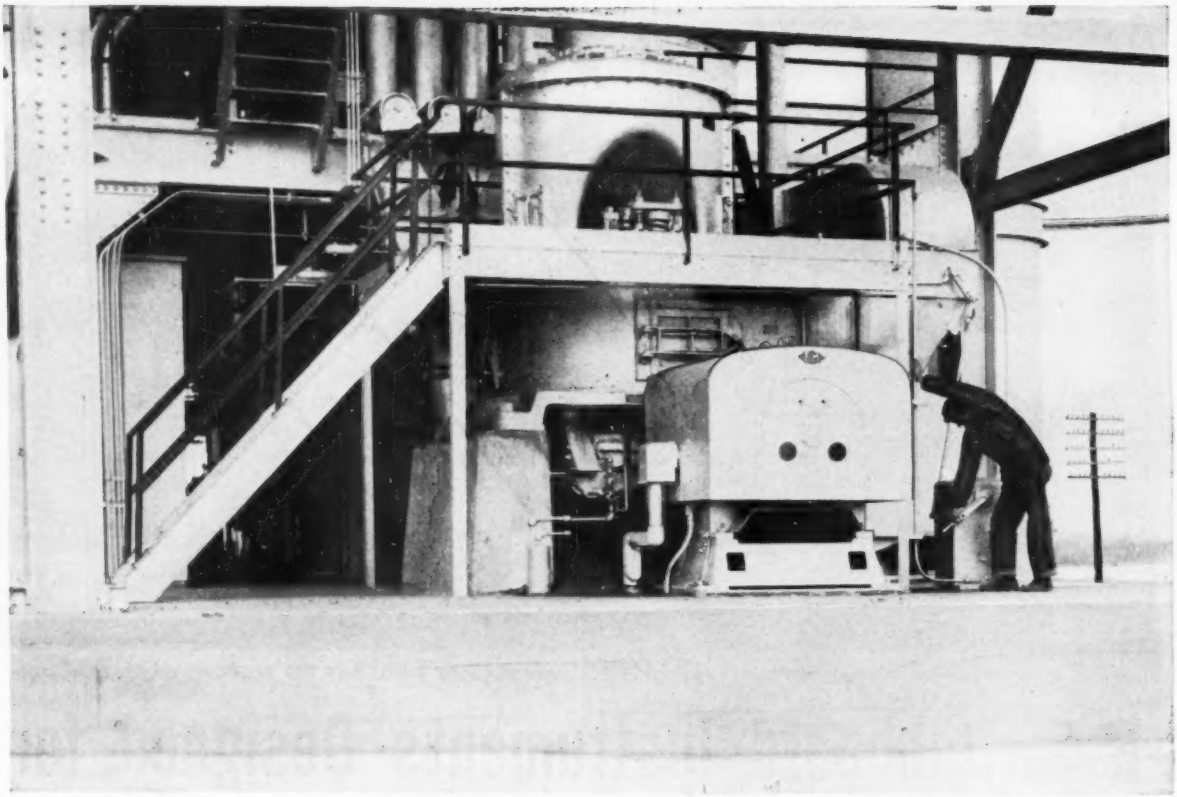
GENERAL ELECTRIC

ONE-PIECE CONSTRUCTION of the magnetic circuit provides a permanent air gap. Flux density remains uniform, making for consistently accurate readings.



TWO SIZES AVAILABLE—4¼-inch and 8¾-inch. The large-size instrument is designed for applications where readings must be taken at extra-long distances.





E-M Weather-Protected Outdoor Induction Motors are ready for steady service under all kinds of weather conditions. Shown above is a 250 hp, 1200 rpm, 2300 volt E-M Squirrel-Cage Induction Motor driving a coal pulverizer at the Lawrence station of the Kansas Power and Light Company. Consider this type of special E-M protective enclosure for your next outdoor drive installation.

Putting them OUTDOORS or *either way, E-Mgineered heavy-duty motors give*

Indoors or out, E-M's new large squirrel-cage induction motors will give you something "extra" in appearance, durability, and reliability on your large high speed drives.

From the smoothly contoured, modern design protective enclosures to the long life, smooth running bearings, E-M Heavy-Duty Induction Motors incorporate many special design features. These features provide maximum protection to insure economical, dependable motor operation. And as motors get bigger, ruggedness and reliability are doubly important.

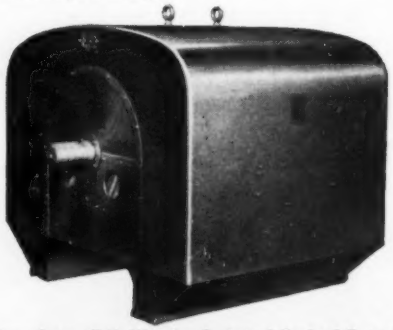
Here are typical features that "E-Mgineered" Heavy-Duty Induction Motor designs give you:

1. MODERN PROTECTIVE ENCLOSURES... Protective enclosures are designed to provide more than adequate protection to coils and bearings... offering at the same time a neat, trim appearance.

2. STURDY FRAME CONSTRUCTION . . . Stator frames are of strong, rigid, reinforced steel plate construction . . . fabricated with heavy, continuous welds, treated to relieve stresses.

3. LOW LOSS STATOR CORE . . . Core laminations are of thin-gauge, low loss, non-aging silicon steel, precision punched to insure true slots. Laminations are individually enameled to minimize stray load losses.

4. LONG LIFE STATOR COILS . . . Stator coils, preformed to fit core slots accurately, have insulation engineered for the application. Leads are carefully bound and sealed. Coil ends are tightly lashed to each other and to heavy bracing rings to prevent distortion on full-voltage starting.



Exterior of new E-M Weather-Protected Squirrel-Cage Induction Motor, designed to provide dependable outdoor service under the most rigorous weather conditions.

The eye-catching motor shown at left is a recent example of E-M's advanced design and construction in the field of 2-pole induction motors. Notice especially how the streamlined enclosure provides adequate protection while giving the motor a sleek, neat look. All details of electrical and mechanical construction are planned with the same care to give the user the utmost in motor performance and dependability.

Bracket-Bearing E-M Two-Pole Squirrel-Cage Induction Motor uses contoured frame and oil pump enclosure for trim appearance. Forced ventilation system with intake and discharge through base.

1300-TPA-2134A

INDOORS?

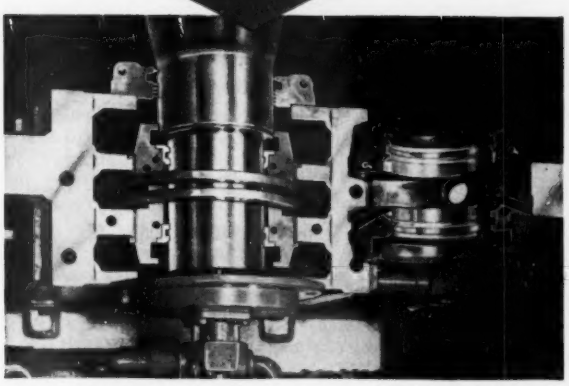
you maximum protection

5. RUGGED ROTOR CONSTRUCTION . . . Rotors have large, strong, stiff shafts and complete, non-segmented circle laminations tightly anchored to shaft or rotor spider. Rotors are precision balanced in a "dynetric" electronic balancer to limits substantially better than commercial standards.

6. LONG LIFE, SMOOTH RUNNING BEARINGS . . . E-M sleeve-type bearings with precision bored babbitt liners, journals with modern one-to-one ratio of diameter to length, and cool oil supply insure reliable, trouble-free operation. Kolene-processed bearing liners are used on large machines and those machines having high journal peripheral speed. Anti-friction bearings are available on some ratings.

For specific details that will pertain to your own requirements, consult your nearest E-M sales engineer. And write the factory for E-M Synchronizer No. 34 and Foto-Facts No. 21, describing what's new and important in the design of large induction motors.

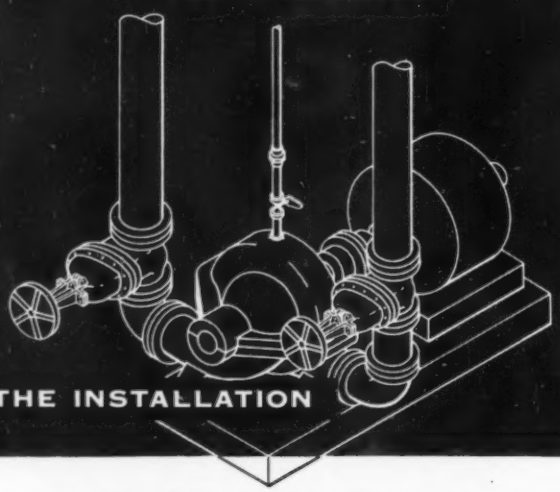
ELECTRIC MACHINERY MFG. CO.
MINNEAPOLIS 13, MINNESOTA



Section of sleeve-type bearing, showing journal, oil rings, linings, and "aerodynamic" pressure seal to eliminate oil vapor leakage.

Will Your Valves Last 50 Years?

...on this Tough Pump Service, for instance



THE INSTALLATION

VALVE SERVICE RATINGS

SUITABILITY:
Doing the job for 50 years

MAINTENANCE COST:
Routine care only

SERVICE LIFE:
Installed 1903—Now on new pumps

OPERATING RESULTS:
No shutdowns for valve trouble

AVAILABILITY:
Catalog item—Current No. 465½

At The Great Western Sugar Company, Longmont, Colorado, plant, with Crane Iron Body Wedge Gate Valves on suction and discharge lines of juice pumps.

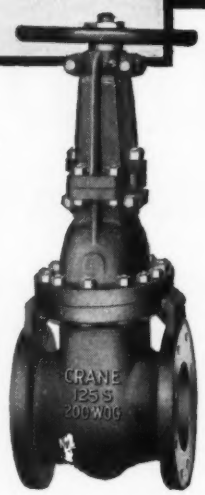
THE CASE HISTORY

Originally the Crane valves were installed on belt-driven pumps when the plant was built in 1903. In 1952, the old pumps were replaced. Nearly all the Crane valves were found in good condition and put right back in service on the new pumps.

It's no easy job these Crane 6 and 8-inch, 125-pound brass-trimmed gate valves have been doing since 1903. The plant operates on 80-day continuous beet sugar campaigns. In spite of intermittent operation, and with periodic routine maintenance only, the Crane valves never fail to operate freely, smoothly, and seat tightly. For 50 years they have assured dependable, positive flow control in event of pump failure—and they're still doing it.

THE VALVE

Here is today's model of these "50-year service record" Crane 125-pound iron wedge gates. Still made to the most rigid quality standards, these modern valves keep building unusual performance records in every industry. They come in patterns for every need. See your Crane Catalog or your Crane Representative.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

No job too big for ELLIOTT approved service shops

Soldering and taping final connections in the big generator stator.

Close-up of service men inside the stator inserting wedges and lashing coils.

The 12,000-kva generator installation.

REWINDING 12,000-KVA VERTICAL WATERWHEEL GENERATOR

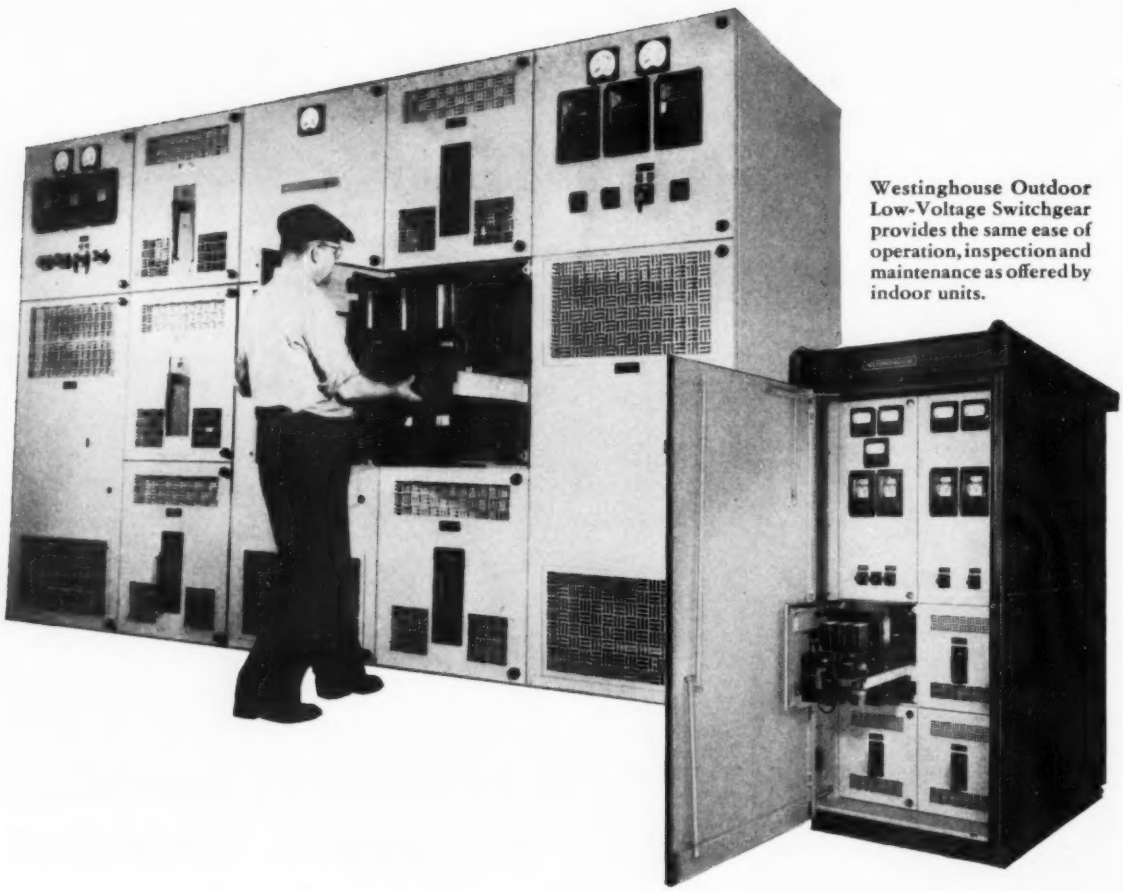
● The Larsen-Hogue Company is one of many carefully selected shops, strategically located throughout the United States, to service all types of electrical equipment built by Elliott Company. Together they comprise a trained and dependable service organization which stands back of every Elliott motor and generator. In addition to these Approved Service Shops, is the staff of Elliott factory-trained Service Engineers, and the repair facilities which are available at the factory for regular or special service.

For the location of the Elliott Approved Service Shop capable of handling *your* service job — no matter what its size — contact your nearest Elliott District Office or write Elliott Company, Ridgway Division, Ridgway, Pa.; or Elliott Company, Crocker-Wheeler Division, Ampere, N. J.

R2-26

ELLIOTT Company

RIDGWAY DIVISION
CROCKER-WHEELER DIVISION



Westinghouse Outdoor Low-Voltage Switchgear provides the same ease of operation, inspection and maintenance as offered by indoor units.

Now . . . flexible protection in less space

WITH WESTINGHOUSE LOW-VOLTAGE SWITCHGEAR

When you specify Westinghouse Low-Voltage Switchgear you get the most flexible low-voltage circuit protection available today. And you get it in compact, unitized enclosures that save valuable plant space . . . save you considerable planning expense . . . can be installed in a matter of hours.

An unusual degree of flexibility results from the modern selective tripping feature of the DB De-ion® Breaker. In a single, compact device, you get the perfect co-ordination of time-delay characteristics, which confines outages to the faulted section alone, to assure maximum continuity of service.

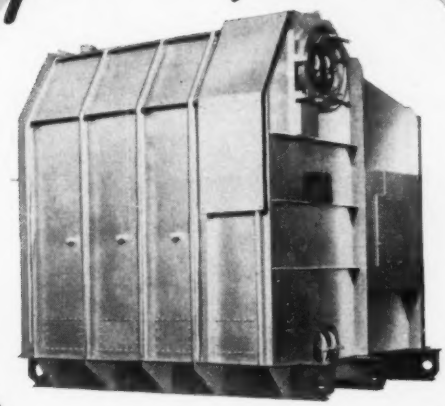
The Westinghouse Low-Voltage Switchgear design provides easy access to all components . . . simple drawout breaker operation . . . a complete metal enclosure for safety. It is available for circuits up to 600 volts, 15,000 to 100,000 amperes interrupting duty, for indoor or outdoor service.

For complete information on Westinghouse Low-Voltage Switchgear, write for Booklet B-5282. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60794

DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

YOU CAN BE SURE... IF IT'S Westinghouse LOW-VOLTAGE SWITCHGEAR

Springfield ... more for your "Boiler Dollar!"

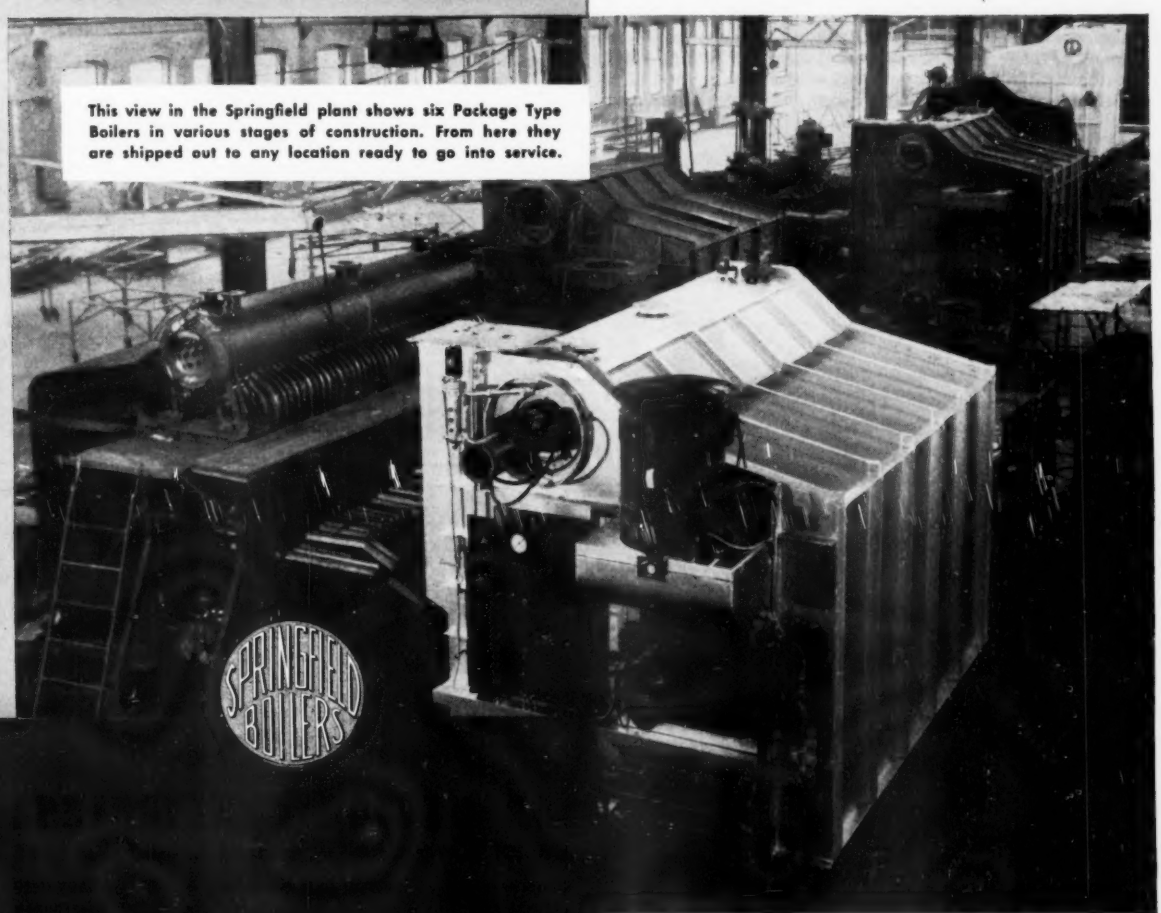


PACKAGE TYPE BOILERS

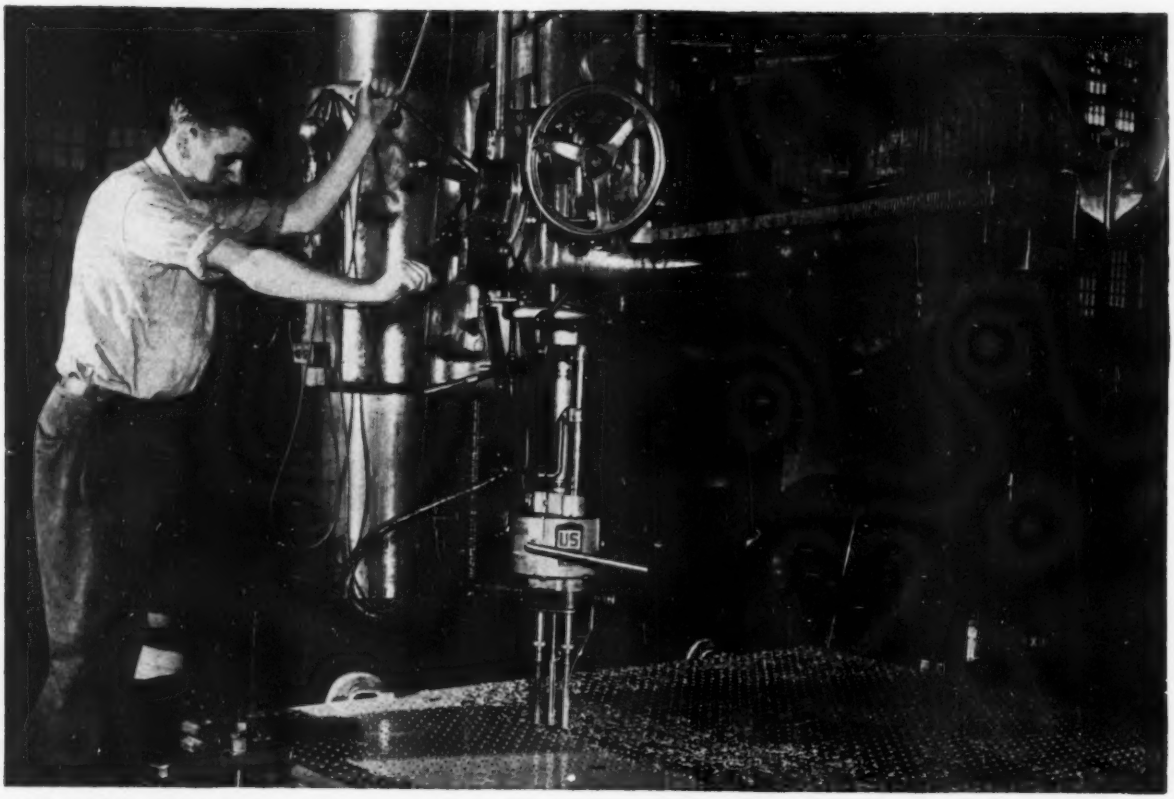
Check with Your Consulting Engineer on Modernization or New Plant Projects

A New High in Value! A New Low in Cost!—that's the story back of Springfield's new Package Type Boilers. From every angle: Design . . . Construction . . . Operation . . . Performance . . . Maintenance—Springfield offers important advantages. And because these boilers are produced in volume, price delivered is very attractive.

Let us give you complete information. Standard sizes are now offered from 6,000 to 33,000 lbs. of steam per hour, or equivalent water ratings in B.T.U., and in design pressures of 200, 300, 600, and 900 psig. Available with up to 100° superheat and combined with external economizers or air preheaters if desired. *Send your inquiry TODAY.*



This view in the Springfield plant shows six Package Type Boilers in various stages of construction. From here they are shipped out to any location ready to go into service.



EIGHT FOOT RADIAL DRILL at Alco's expanded Dunkirk plant has multiple head for the precision drilling or reaming of several holes simultaneously. Special machines like this, many of them Alco-designed, all of them operated by veteran craftsmen, are an important part of the Alco method of producing economical, effective answers to the toughest of metal-fabricating problems.

ALCO engineers and craftsmen provide...

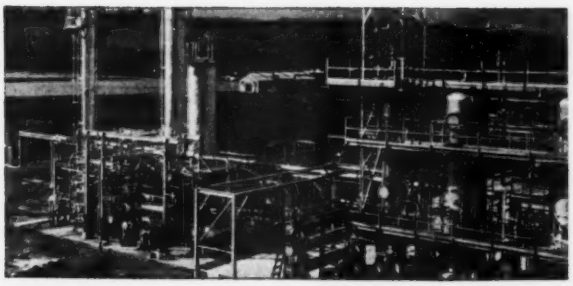
Answers to

Through many years of working closely with engineers of petroleum, chemical, power and manufacturing companies all over the world, Alco has developed economical, effective methods of solving new industrial problems.

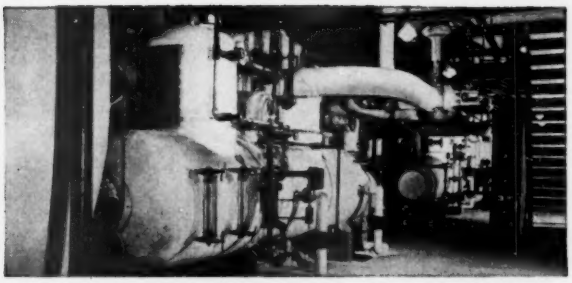
The first step is a thorough exchange of ideas between the client's production engineers and Alco's designers and mechanical engineers. Then, Alco prepares complete design details and fabrication specifications, leaving the client's engineers *free to concentrate on fundamentals.* Finally, veteran Alco craftsmen fabricate the finished product.

Result: substantial savings to the client in original equipment costs and, frequently, in subsequent operating costs.

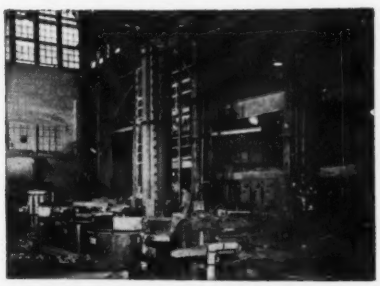
Next time you have a metal-fabricating problem—a problem that calls for specialized equipment or new ways to speed up production—we invite you to let Alco work out the answer. Contact your nearest Alco Products Sales Engineer at New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, Beaumont, or write direct to Dunkirk, N. Y.



NEW POZA RICA NATURAL GASOLINE PLANT, part of Mexico's growing petroleum industry, uses Alco heat exchangers in many processing steps—plus Alco flash-tower heaters, depropanizer condensers, depropanizer feed heaters, depropanizer bottom coolers and other related units. Operated by Petroleos Mexicanos to meet the needs of Mexico City, the new plant can produce with its Alco equipment approximately 168,000 gallons of natural gasoline per day.



"FLEX-TUBE" EVAPORATORS at the Manila Electric Company's Rockwell Station, Manila, P. I., can produce approximately 5000 pounds per hour net vapor with no more than 1 ppm of impurities when water concentration in the shell is no more than 1500 ppm. With its patented Flex-Tube construction, this unique Alco evaporator offers industry the only positive-acting thermomechanical descaling device for straight tube installation.



NICKEL-PLATED STEEL PIPE for an important project had to be produced to meet a tight schedule and the most exacting specifications. With special production facilities and the concentrated efforts of skilled designers, engineers and craftsmen, Alco met the quality requirements —and made deliveries to the customer on time. Here a 20-ft length, 30-in. in diameter is being lowered into one of Alco's huge vertical plating tanks.

ALCO AIRCOOLERS will handle about 80 per cent of the cooling load at the Celanese Corporation's new chemical plant at Pampa, Texas. Designed to solve the plant's individual problems, they have twin 11-ft fans (one motor-driven, the other vent-gas-turbine driven), removable exchanger heads, tube bundles that slide out on their channel frames, and stainless steel parts wherever the equipment is exposed to process liquids.

TWIN TRUNK MAINS of Alco steel pipe 60 in., 54 in. and 48 in. in diameter, with wall thicknesses of ½ in. and 7/16 in., were installed by the city of Philadelphia to replace smaller cast iron mains. Fabricated on huge bending rolls and welding machines at Alco's Dunkirk plant, they are typical of the many miles of special steel piping furnished by Alco over the years for many of the largest municipal and industrial water supply systems.

New Industrial Problems

ALCO

ALCO PRODUCTS DIVISION

AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK

OPERATOR CHECKS READINGS OF HAYS ELECTRONIC OXYGEN METER WHEN BURNING MULTIPLE FUELS

THESE INNOVATIONS IN BOILER PLANT INSTRUMENTATION ARE MAKING NEWS

New instruments meet demands of outdoor boilers, space saving, greater speed of response, multiple fuel firing

Boiler plant instrumentation is changing.

Electrically operated combustion control is being used more and more as larger numbers of outdoor boilers are installed. For all-weather operation electric combustion control is preferred since electricity doesn't freeze, is readily available, doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

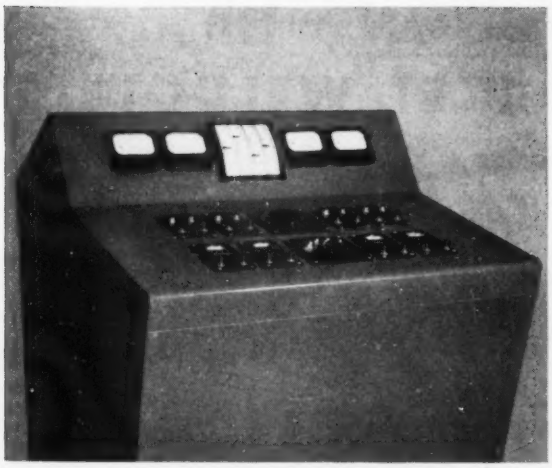
More miniature indicators and control stations mounted on console or graphic panels are appearing as operators demand more instruments in less space. All essential information is concentrated for fingertip control while supplementary indications and recordings are located on adjacent standard size panels.

Electronic instruments are becoming more numerous because they give faster speed of response and greater accuracy, can be placed anywhere, eliminate pressure lines into the panel.

Oxygen recorders have become standard equipment where fuel flexibility is desired. Unlike other combustion guides, oxygen measurement is unaffected by the varying Hydrogen-Carbon ratios of different fuels, hence gives the *only* accurate check where more than one fuel is being burned.

In response to these trends The Hays Corporation offers the complete, modern boiler plant instrumentation line including electric combustion control; highly visible, internally illuminated Miniscales; custom-made panels; new electronic mercury-less flow meters; new 1, 2 and 3 element electronic feedwater control; combustion guide instruments of every type including the Magno-Therm electronic oxygen recorder.

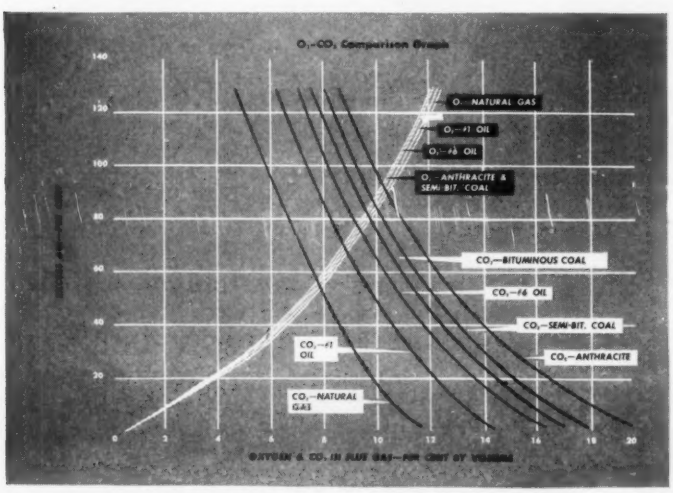
Write for free bulletins on any of these products—available from The Hays Corporation, Michigan City, Ind.



MORE INSTRUMENTS IN LESS SPACE has been accomplished with Hays Miniscales on a console panel. Miniscales indicate any variable. Transmission is either electrical or pneumatic on highly visible, internally illuminated 5" scales. Hays console panels are custom-made to conform to individual specifications.

OUTDOOR BOILERS, which eliminate the need for expensive enclosures, demand all-weather dependability from controls. Hays all-electric combustion control doesn't freeze, eliminates expensive dryers and compressors.

ELECTRONIC INSTRUMENTS have greater speed of response and accuracy. Here operator inspects transmitter of new Hays electronic mercury-less flow meter. Recorder can be located at remote distances from transmitter.



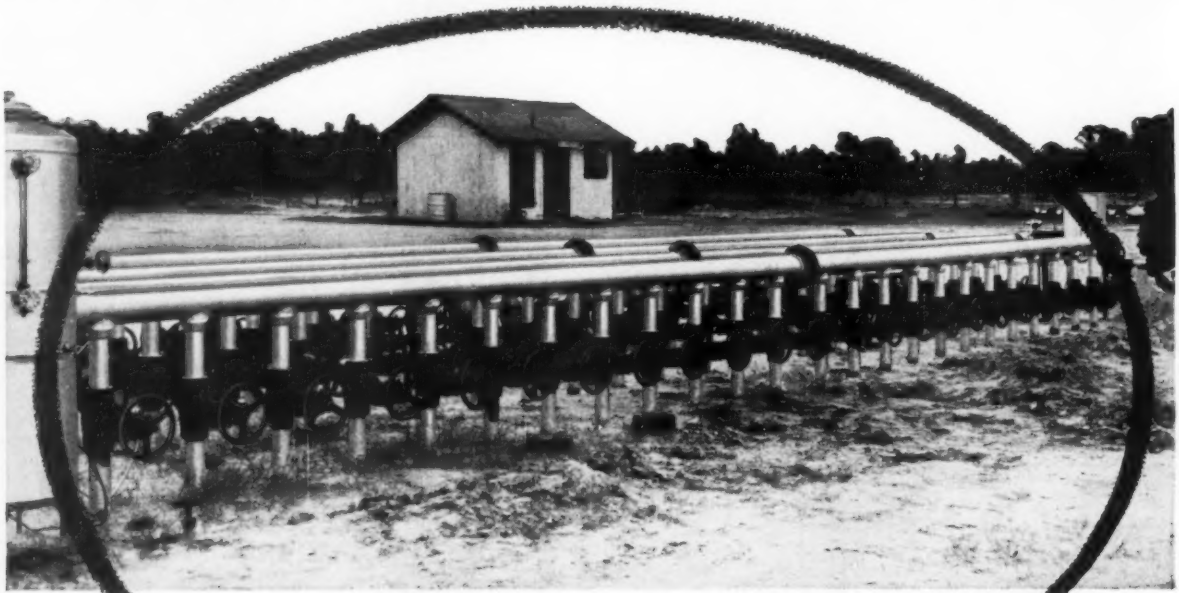
IN BURNING MULTIPLE FUELS only O_2 gives an undistorted picture of excess air present in flue gas — as demonstrated by this graph.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

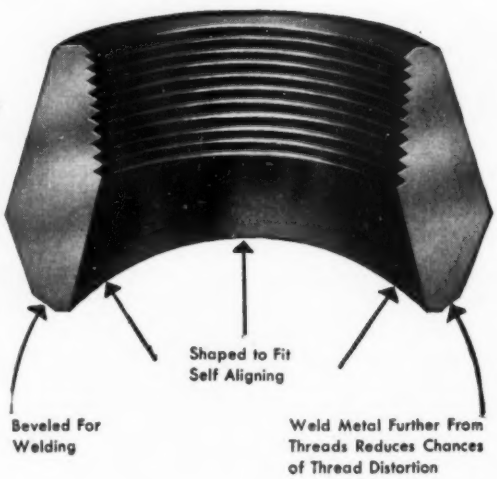
THE hays CORPORATION

MICHIGAN CITY, 3 INDIANA

BOOST YOUR PRODUCTION with THREDOLETS and SOCKET WELDOLETS!



ThredOlets at work in L. P. Gas Plant Production Separators. 4" x 2" ThredOlets utilized for branch connections on manifolds subjected to contraction, expansion and vibration. The ThredOlet's short height and wide footing creates rugged branch construction.



Insure production economy in pipe fabrication through the *exclusive* features *engineered* and *manufactured into* ThredOlets and Socket WeldOlets. Production is boosted because you weld *more pieces* per hour!

Instant application and immediate availability will save you time, labor and money in constructing all 90° Threaded and Socket-weld branch connections.

SPECIFY AND USE...
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FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 WELDOLET CATALOG
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ThredOlets

Socket WeldOlets

Your Diesel Yardstick

ARE YOU A PLANT OWNER weighing the purchase of a diesel? A sales engineer seeking to convince the owner of diesel economies? A consultant studying competitive power-plant costs? Or a plant operator wondering how your diesel plant stacks up against others?

If you are in any of these spots, you need reliable, unbiased figures on plant performance and operating costs.

You will find this brass-tacks information in the *Report on Oil and Gas Engine Power Costs,* issued annually by the Oil and Gas Power Division of ASME.

The current edition contains data on 470 oil and gas engines in 123 plants—more than half a million rated bhp of engines generating over 800 million kwhr. For each plant the *Report* gives full details on fuel and lube costs, attendance and supervision, maintenance and repair.

But that's not all; it gives the other facts you need: type of engine, kind of fuel, installed capacity, type of load—with data on major repairs and the number and duration of enforced shutdowns. For perspective (after a long stretch of inflation) you will want some comparative cost figures for past years. You find these, too—and other things you might not have thought of—in the *Report on Oil and Gas Engine Power Costs.*

In short, this is a book of essential facts assembled by practical diesel men of long experience. It is issued every year under the direction of a special subcommittee of the Oil and Gas Power Division, with the cooperation of Edison Electric Institute.

Most important of all is the essential cooperation of plant owners and operators all over the United States. Thirty-eight plants have contributed data covering 20 years or more of diesel-plant operation.

If you own or operate diesel engines, you should be part of this cooperative team; just drop a note to M J Reed, Chairman, Subcommittee on Oil and Gas Engine Power Costs, ASME, 29 West 39th St, New York 18, N. Y. Tell him you want to supply data on your plant. Books are now closed on 1952 data, but he'll see that you get a 1953 questionnaire form to fill out.

If you're part of the team already, send your figures in promptly. To give faster service to diesel users everywhere, the Committee is trying to cut down the time lag between start of data collection and the issuance of the *Report.* Prompt receipt of questionnaires will help. Incidentally, every contributor receives a complimentary copy.

Next edition, covering 1952 data, will appear late this year. Place your order for it now ($2.50 per copy; discounts for ASME members and for quantity orders). Studying it means dollars in the pocket to anyone concerned with diesel and gas-engine plants.

"TOM: —
IN THE FIRST YEAR AFTER WE CHANGED OUR PLANT TO FUSETRON FUSES, WE ENTIRELY ELIMINATED MOTOR BURNOUTS FROM SINGLE PHASING AND REDUCED ALL MOTOR BURNOUT BY AT LEAST 75%"

(Excerpt from a conversation of Forrest Baumgardner with Tom Wier)

FORREST BAUMGARDNER, *Chief Electrician*,
Frank Wheatley Pump & Valve Mfr.
Tulsa, Oklahoma.

"FOREST:— DON'T FORGET FUSETRON FUSES DO MORE THAN PROTECT MOTORS — THEY PROVIDE 10 POINT PROTECTION!"

TOM WIER,
BUSS Fuseman,
covering Tulsa, Okla.

1 Protect against short-circuits.*

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

* Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

Here's why FUSETRON Fuses give All Purpose protection...

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses, FUSETRON FUSES fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co.

Don't Risk Losses!

One **lost** motor . . .
One **needless** shutdown . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

Bussmann Mfg. Co., University at Jefferson,
St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

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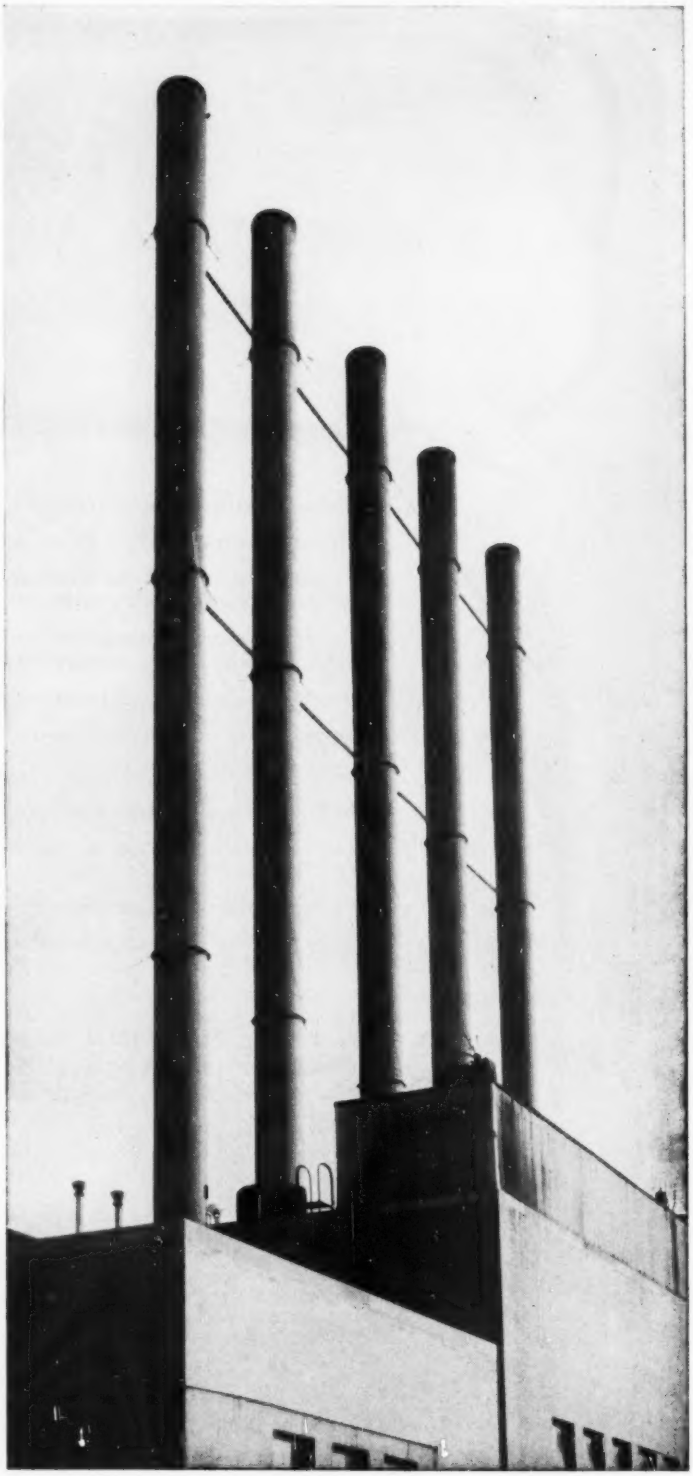
This Modern Chemical Producing Plant Used

BYERS WROUGHT IRON PLATES

TO KEEP THEIR STACK INVESTMENT FROM GOING "UP IN SMOKE"



Because stack maintenance comes high, engineers of this modern chemical producing plant got "down to earth" facts before they selected material for the five new stacks at the Company's Chemical Plant, Louisville, Kentucky.

A thorough investigation of wrought iron's corrosion resistance, and past records of the material in stack service, indicated wrought iron plates as a solution to excessive maintenance and repair. The stack fabrication and erection job was turned over to W. E. Caldwell, Louisville. The stacks are 126 feet high and 54 inches in diameter.

With today's high maintenance costs, it's just plain good business to assure that every metal stack lasts as long as possible, with as little attention as possible. The importance of this move increases as stacks grow taller, for the higher the stack—the higher the cost of maintenance.

Byers Wrought Iron plate is a veteran in stack service. Engineering records provide convincing evidence of its superior durability. You can review some of these records, and see how wrought iron has helped others solve the problem of premature failure and maintenance by writing for a copy of our bulletin, WROUGHT IRON FOR FLUE GAS CONDUCTORS AND COAL HANDLING EQUIPMENT. It may help you . . . so write today.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

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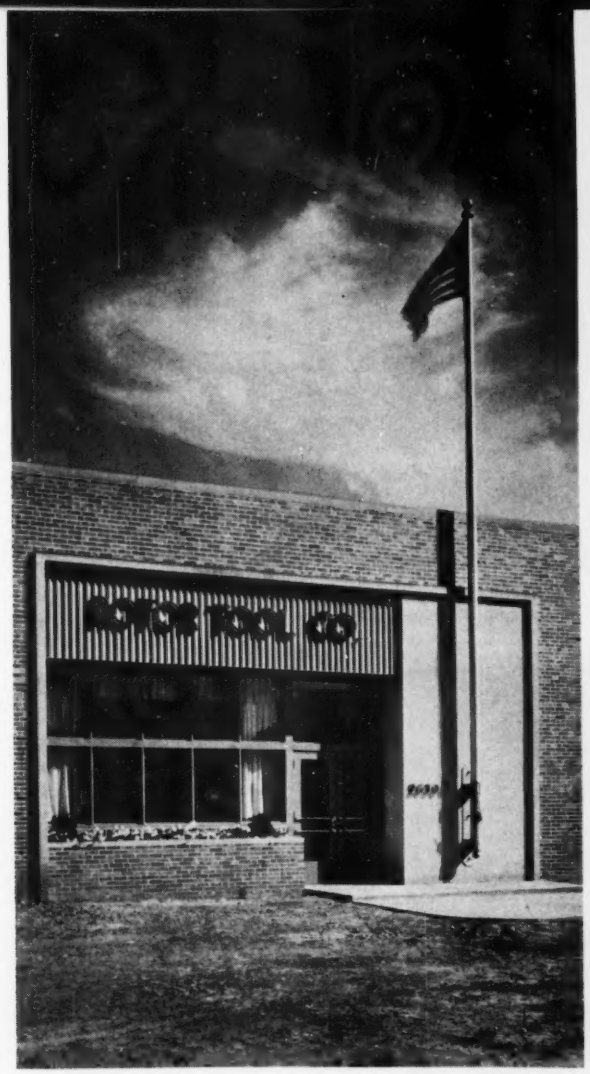
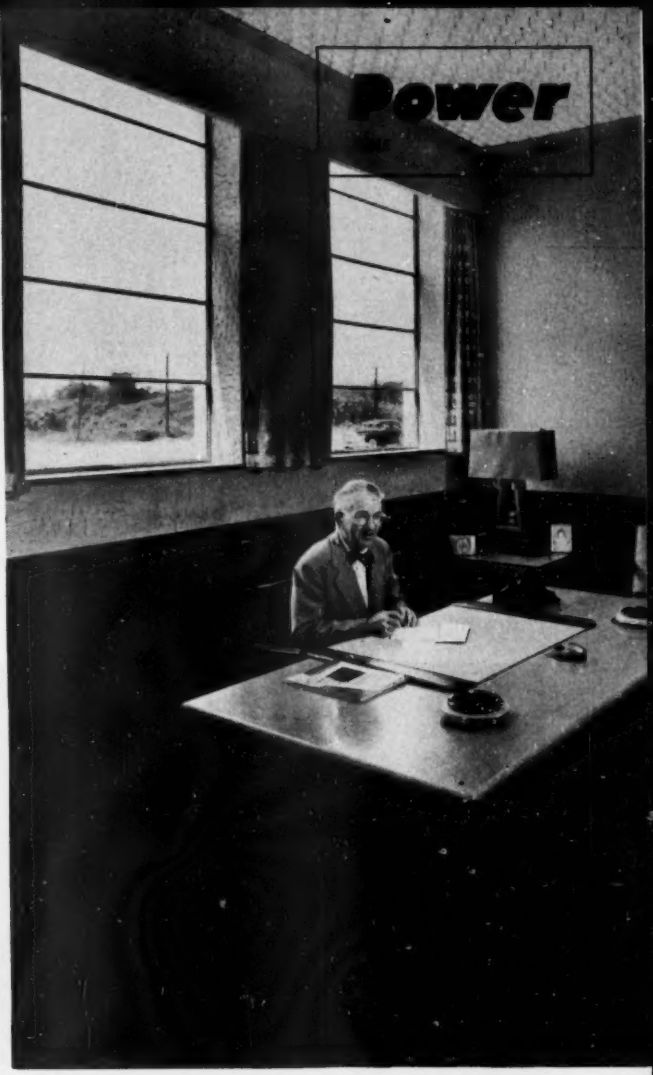
TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



CLEANLINESS, highly valuable asset in any machine shop, is evident from the moment you enter the doors of this new plant



PRESIDENT'S OFFICE, along with the other administrative areas, draws its conditioned air from two packaged units

Air Conditioning Gives You Fast Money Return

By H P BAILEY, *President, Rotor Tool Co*

Metal-working plants, ready victims to the whim of both temperature and humidity changes in the weather, can buy their independence with fully air-conditioned plants. They will pay prompt returns in less rusting and higher worker efficiency

► WITH PRODUCTION COSTS going the way they are, plant management is always on the alert to cut costs and improve output. When our 40,000-sq-ft plant went up, we were on the lookout for any idea that would fit these aims. Air conditioning seemed like one. But would its promised advantages pay off against its costs?

Advantages. To our way of thinking, going to a partial system of air conditioning is shortsighted. An ideal climate for our production entails inside air at 80-F dry bulb, 50% relative humidity even when outside air measures 95-F db, 75-F wet bulb. A partial system that approached this ideal would cost about as much as a complete installation, so we based our plans on full-plant coverage. With it we expected three major advantages: cleanliness, temperature control, improved worker efficiency. All would give direct

PLANT-PRODUCTION area, some 32,000 sq ft, is conditioned by a 112-ton refrigerating compressor, evaporative condenser, plus required ductwork at a cost of $1.27 per sq. ft. Entire job for full plant ran 15% over costs for building and land

TEMPERATURE control gave immediate benefits in the way of more ability to work toward the close tolerances needed to produce direct labor and material savings

REJECTS at final inspection stage drop as direct result of a cleaner plant, steadier climate, greater work efficiency. And it costs only an additional 3¼c per worker hr

Plant Production Shows

benefits measurable in dollars and cents.

Cleanliness we rate first. Our products are highly finished metal parts, usualiy small in size with close limits. In the past, moisture and rust action between operations handicapped us. Completely eliminating problems from these causes would be a major advantage—one that represents direct savings from less stock loss, fewer repeated machinings.

Second, and almost equal to cleanliness in our output, is the factor of temperature control, particularly during machining. In our old plant we ran into trouble with temperature variations since we work to tolerances as low as 0.0003 in. on some operations. These temperature-induced problems showed most on magnesium, which we use to obtain a lighter-weight portable tool—our major product. Air conditioning would cut down these troubles from temperature changes, and certainly produce a return in labor savings from less tool resetting.

Lastly, air conditioning ought to combat a fall-off in worker efficiency that hot weather made quite noticeable at our old plant. (While it is too early to get conclusive figures, with our start-up dating back only to June 1952, our expectations seem sound. Worker efficiency looks as if it will reflect a 3 to 5% improvement as a steady factor Further, with uniform, summer shop temperature of 80 F and relative humidity of 50%, the shop can work on days when neighboring plants shut down because of extreme weather.)

Costs. The three advantages cited offer respectable savings—mostly in labor. And labor runs $1.75 per hr. plus fringe

SALES OFFICE, part of the 8000 sq ft of space conditioned with packaged units at a cost of $0.93 per sq ft, employs a small hot-water heating setup to supply the heat losses in winter months from around the window or the "cold-wall" areas

Sharp Improvement With This Full-Scale Shop Air-Conditioning System

benefits of another $0.25 per hr. On top of this $2.00-per-hr direct labor charge goes a factory overhead of another $2.00 per hr, to give a total production cost of $4.00 per hr. So the savings possibilities that air conditioning offered seemed most attractive if we could put one in and run it for a nominal amount.

Our desired plant climate, as mentioned, was an air at 80 F db and 50% relative humidity. For design purposes we picked an outdoor air of 95-F db and 75-F wb. There are installation and operating advantages in engineering the air-conditioning and heating systems together. In a plant the size of ours we felt it more feasible to select a central warm-air heating unit, and distribute air through ducts to the manufacturing areas. Initial cost for such a system would amount to about $0.17 per sq ft more than going to unit heaters, but lower annual charges should more than offset this. Further, we could freely mix fresh air with recirculated air, diagram, right, to give a highly suitable, winter plant condition.

Basic load for summer cooling and dehumidifying was our major consideration. We figured it on number and size of internal lights and rating of the power-driven machinery, about 73,500 watts. To this we added a load of 125 persons. The variable-cooling load depended on the construction, such as type of roof and side walls, as well as window area. We went through the heavy-discussion stage of how much window area made sense. Construction was more expensive with plain walls than windows. But we did limit the window area to reduce our air-conditioning variable load. If we had it to do over, we'd reduce window area still lower, but never to the point where it cramps the satisfying feeling of looking out easily.

After all considerations were in we decided to supply the shop with 50,000 cfm of conditioned air at 61½ F to meet a load of 115 tons. The office-area load, which was much easier to decide, represented about 13 tons. We met this with packaged air-conditioning units, one 5 and one 7½ tons.

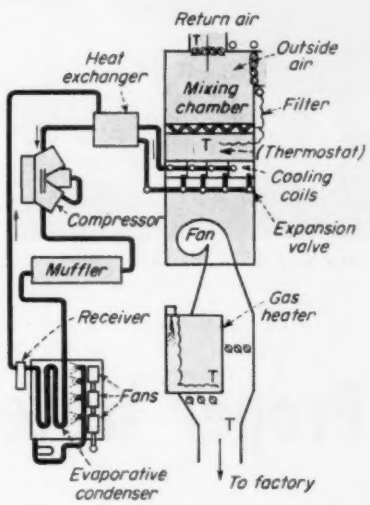
Total air-conditioning cost came to $48,174 ($1.20 per sq ft). Of this total, $7450 went for the office at $0.93 per sq ft, and the remaining $40,724 for the shop at $1.27 per sq ft. All in all, it represented a 15% addition to our expected building and land outlay.

Annual maintenance and operating costs we guessed at with a write-off of 15 years for equipment, representing $3211 per yr, and $1375 for annual maintenance. Power charges, as we found out later by separate metering, amount to about $225 per month. Total operation and maintenance costs broken down by worker hours give an average of 3¼c per employe hr. This cost against our $4.00-per-hr production figure stacks up as only about 1% more. Expected returns from the three major advantages we outlined will meet this extra cost with a comfortable margin to spare.

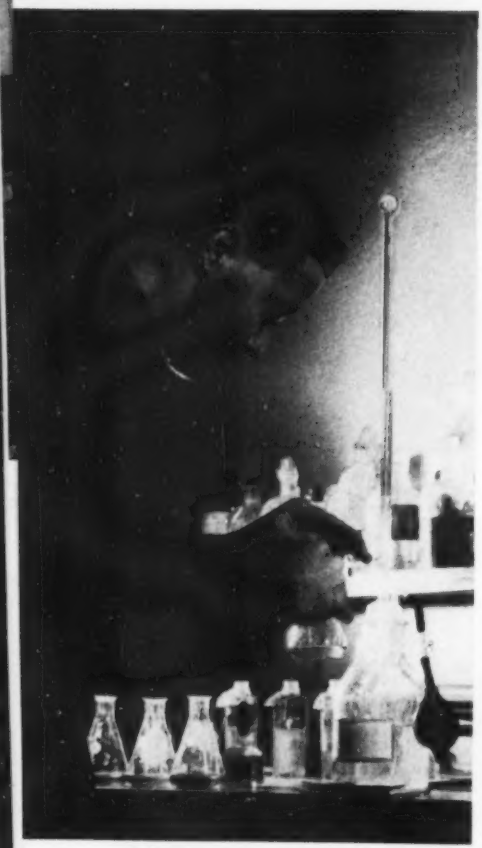
Air-Conditioning Plant. The diagram, at the right, shows basic layout of the air-conditioning plant we put in. For winter we heat fresh air, and blow it out into the plant. Depending on the heating-needs supply, air temperature varies from 75 to 100 F, but there is no feeling of hot and cold blasts.

In warmer months, the dampers controlling outside and recirculated air are interlocked so all cooling is done with outside air when its temperature is below 65 F. When outside air is above 65 F the dampers go into their recirculating positions. The refrigerating machinery then does the cooling and dehumidifying. Exact percentage of outside air entering the plant is controlled automatically to give a predetermined mixed-air temperature when combined with recirculated plant air.

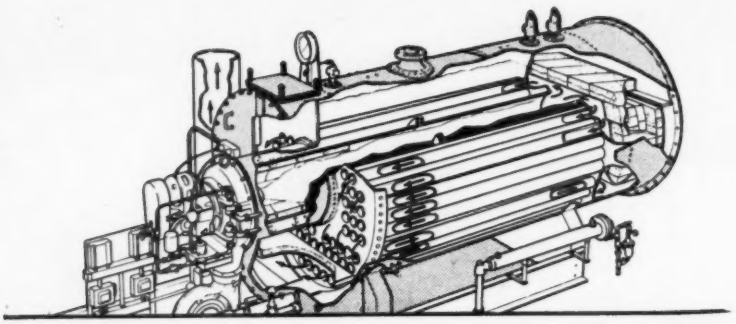
An exhaust system, capable of removing 30,000 cfm whenever the air-conditioning system is on 100% outside air, ties into this damper arrangement.



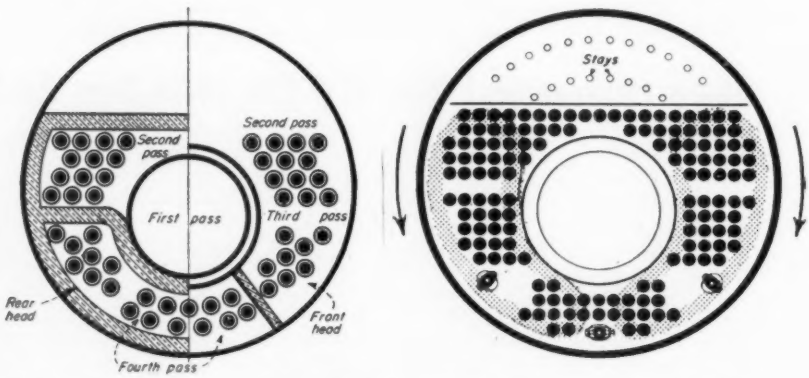
SCHEMATIC diagram shows how heating and air conditioning are combined



DAY-BY-DAY control is a must if you want satisfactory internal conditions



1 Packaged firetube boilers feature a cylindrical combustion chamber surrounded by heat-transfer tubes that prove very hard to get at for mechanical cleaning



2 Gas travels along combustion chamber, around baffles, left, through return tubes; water moves in two ovals, most active steaming occurs next to furnace

Proper Water Treatment for Packaged

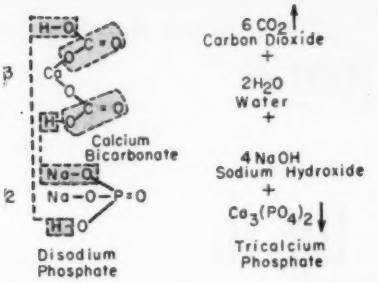
Here's a type of boiler that has now become strong in the steam-generation field. The right water conditioning helps it stay on the line, perform at rated outputs, give little trouble. Don't miss these practical tips for smoother service

By **PAUL BRINDISI**
Chemical Engineer, Celco Laboratories

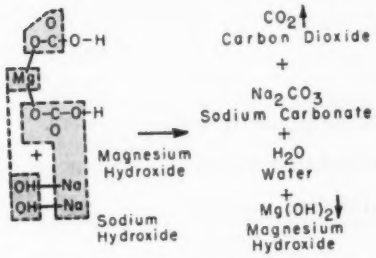
► IN RECENT YEARS, plants of small to moderate size have gone over strongly to firetube package-type steam generators. With their compact assembly on a common base frame, these units are easily and readily installed. Moreover, they prove economical, space saving and quite efficient. We feel this series of articles on boiler scale should include the proper method of internally treating these packaged boilers.

Design. Units come in sizes ranging from 600 to 40,000 lb per hr (20 to 600 hp) for operating pressures up to 250 psi, Fig. 1. They can be either oil or gas fired, although the former is much commoner, and are equipped with forced or induced draft. Their design is patterned along that of a single-furnace Scotch-marine (hrt) boiler. One particular make includes a wet back, while all the others have the conventional dry back. The internal, cylindrical combustion chamber generally centers slightly below the horizontal diameter of the shell, although sometimes it may be as low as midway in the lower half of the vertical diameter. In the smaller units this furnace cylinder may be straight construction, whereas in the larger ones it is always corrugated for greater rigidity and expansion. Units usually have a surface blowoff tapping, and one or two bottom blowdown connections, depending on their size.

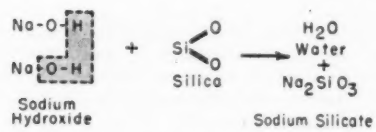
Gas Travel. The 2-pass design employs a single ring of relatively large-size tubes around the furnace cylinder. Here gas merely travels along the combustion chamber and returns through these tubes. The 3- and 4-pass boilers have a row of tubes across the furnace cylinder's top and three to five three-quarter rings of tubes in the water sec-



3 Calcium hardness precipitates out when disodium phosphate is added



4 Boiler water's caustic alkalinity will remove magnesium hardness from it



5 Silica stays safely in solution if caustic alkalinity is strong enough

Boilers

tor of the shell. Rear and front gas corridors are baffled, Fig. 2, to divert gas first into one set of tubes, then back through another. Gas may be made to travel through groups of tubes progressively—from top to bottom, from bottom to top, or from inside to outside.

Water Circulation. Most package boilers use water inlets on both sides, usually midway from the ends and about a quarter of the way up from bottom of shell. One may be for raw-water entry, the other for direct return of the condensate. Or else, one may be used for combined feedwater, the other serving only as an auxiliary inlet.

Water circulation on either side of the furnace cylinder is in somewhat the shape of a crescent oval, Fig. 2. Fresh water courses down along the comparatively cool side of the shell nearly to its bottom, up through the lower and middle tubes, around the combustion chamber, then over the top and the side tubes, and back along the shell again.

Gravity and this counter-flow action of the two water-circulating ovals tend to accumulate sludge along the shell bottom. Since this is the coolest part of the unit, sludge collection here is most desirable. But water circulation is quite rapid and turbulent, and the main body of boiler water cannot be maintained as turbid-free as with some other boiler designs. Because of this, package-type units need a slightly higher rate of blowdown, and you have to rely more on getting effective sludge removal during the light-load or idling periods.

Scale Formation. Since the combustion chamber is the hottest part of the unit, most of the steam generated comes from the water layers lining this cylinder. Scale deposits heavily around this chamber, and probably more so on its forward section. The deposit itself runs harder, is of denser texture and a more adherent nature on the furnace cylinder than deposits on the tubes or shell. Further, these sides and the bottom of the combustion chamber are virtually inaccessible for wire brushing or chipping, so water treatment for keeping this cylinder scale-free becomes a primary concern. Corrugated furnaces present an even tougher problem for mechanical scale removal. Because of these facts you want especially to avoid any silicate scale deposits within these corrugations. We know these scales are highly resistant to either mechanical or chemical cleaning.

Your boiler probably won't suffer any appreciable heat loss while scale is forming on its furnace cylinder. The long travel that gas must make through the various passes insures a later recovery of most of the escaping heat. Damage, though, will be to the combustion chamber from extended overheating caused by scale insulation, and may well be quite severe and costly.

Similarly, tubes may fail as a result of scale, general corrosion and pitting, or fatigue, just as those of any other hrt boiler. With the exception of a few types, package-unit tubes are inaccessible for proper mechanical waterside cleaning. So you must rely on proper water treatment. Since there's no direct flame on the shell of packaged boilers, it won't scale as heavily as the older hrt boiler designs.

Corrosion. Inadequately preheated or deaerated makeup water may develop serious corrosion conditions at the point of fresh-water entry into the boiler. Most of the dissolved oxygen in this colder water escapes immediately upon contact with hot boiler water. Then this corrosive gas tends to attack shell metal in the vicinity of the inlet as well as the exposed feed baffle plate and tube areas. The remaining dissolved gas boils out of this incoming water, to cause possible general corrosion or pitting along the water-level belt of the shell. What oxygen does escape with the steam teams up with carbon dioxide in the condensate to threaten later grooving in the return lines or a direct attack on the fitting threads.

Carryover. The limited steam space renders a packaged boiler readily susceptible to priming and carryover. Its rapid steaming rate and high output add to its sensitiveness. As a result you can't carry boiler-water chemical concentrations as high as you can in many other designs. Hence, you need to exercise great care over blowdown control and internal treatment feed if you want to avoid carryover. Most of these boilers are fitted with a dry pan beneath their steam outlet. But where steam is to be used for process, it is often necessary to insert a steam separator in the main header as well.

External Treatment. Presoftening of makeup water external to the boiler is always desirable. But the expense and additional operations are not ordinarily justifiable in the packaged-unit pressure range. If soft water is also needed for process, or if little or no return condensate gets back, or if raw water's hardness runs very high, external softening may pay. Otherwise, internal treatment alone serves quite well.

Where you do use external softening, the physical and chemical characteristics of your raw water dictate the exact method. The lime-soda type of softener raises no difficulty since it reduces raw-water hardness and alkalinity content. Whereas sodium zeolite removes virtually all hardness, it still leaves the original alkalinity unaffected. Since the package unit is extra-sensitive to high boiler-water alkalinities, such a free concentration of the raw water's alkalinity in the boiler may prove troublesome. You can then control carryover only by excessive blowdown. In such circumstances, acid treatment of the sodium zeolite's effluent or a combination sodium-hydrogen zeolite softener would be the proper external softening method.

Corrosion Correction. Just as for any boiler system, deaerating the boiler feedwater is most desirable. With it you rid raw water of as much of its dissolved oxygen mechanically as is economically feasible. In so doing you hold down the need for chemical correctives and, too, their cost.

Where a separate deaerator is not installed, the package assembly usually includes a receiving tank. If this tank

(*Continued on page* 222)

HOW TO ORGANIZE YOUR NEW POWER PLANT—1

313 Items to Follow Up in Designing a New Plant

First installment of a practical series on selecting, designing, constructing, starting, operating and maintaining modern electric-generating stations to give most economical service

By D C SWIFT, *Ebasco Services Incorporated*

► THE DESIGN of each power plant grows out of a series of compromises. Adjustments must be made according to the location, climate, usable space, fuel, equipment availability and price. Ideas of both designer and owner influence plant arrangement, equipment selected and the building. These compromises frequently produce features undesirable from an operating, maintenance or testing standpoint.

The person responsible for starting and testing the new plant should, if possible, have the opportunity to review the plans as they progress. He may save considerable time and expense by (1) suggesting changes to make operation simpler, safer or more economical, and (2) checking to see that test points and instruments are properly located and available.

Even more important, those who are to supervise operation and maintenance should review and critcize the plans as they become available, and are revised. This should keep everyone satisfied and happy with the setup in years to come.

Local conditions and practices, or likes and dislikes, may indicate the desirability of altering plant design in greater or lesser degree from usual arrangements. A list of special features desired should be prepared. After checking on the costs involved, and discussion and approval by all interested parties, these additions should be incorporated in the design.

Check list on pp 79-81 has shown by long experience to include desirable features of plant design. As the design progresses a periodic review of the plans, using the check list and a list of special features as guides, will show whether items are being satisfactorily taken care of. Those that are not should be studied to arrive at the best possible compromise.

This list will not replace capable design knowledge and experience, but it can help considerably in insuring that items are not overlooked. Incorporation of these items into the design at the earliest possible point saves considerable time and expense in getting the plant into operation. Representatives from the owner's engineering or operating organization should be designated to follow design closely. They should carefully scrutinize purchase orders and design prints to check on the various features before actual construction goes too far to allow changes.

Models built prior to construction are often used to assure satisfactory appearance and adequate operating and maintenance clearances. While the cost of model construction may seem rather large, it usually runs much less than one percent of total plant cost. Without first checking in model form, more than this amount may be spent in redesigning and making field changes to correct unforeseen conflicts of piping, ducts, and building steel.

Even with a model, closest cooperation between structural, mechanical, and electrical design engineers is needed to prevent interferences of equipment in the field. As prints reach the plant under construction, they are often checked for interference by the men who will be responsible for running the plant. Last-minute field changes cause delay and expense, and at times other unforeseen complications.

Specification preparation is one of many important services rendered by designers and consultants. Specifications for equipment and building may be quite complex, requiring considerable experience to prepare satisfactory ones. Preliminary specifications are usually revised to describe more exactly the unit to be eventually purchased. The revised form usually is included as part of the purchase contract, giving information on details of equipment design and performance. A complete set of purchase orders and specifications should be available to the testing crews and operators for their information.

Purchase orders should specify that the manufacturer furnish an adequate number of instruction books and construction prints. These should be made available to operators and repairmen responsible for the machines. Where the manufacturer is to supply special service or instruction, the details and cost should be included in the order.

The form and legal provisions for payment, delivery, guarantees, etc, must be carefully worded, and should be prepared by an experienced purchaser.

General Design Considerations

1 Adequate site area for present and future expansion.
2 Adequate water supply for present and future needs.
3 Plant above flood level or protected against high water.
4 Plant oriented for best railroad, transmission-line approach.
5 Plan for future expansion considered in plant general design.
6 Future fuel changes considered in plant design.
7 Fuel cost and availability, load-factor variation, makeup-water needs, operating personnel, prevailing conditions considered in choosing equipment and steam conditions.
8 Boiler, turbine, electrical operating levels on same floor.
9 Convenient passageway between main operating areas.
10 Adequate room for operation, maintenance around equipment.
11 Roadways accommodate large trailer trucks in reaching turbine-room crane.
12 Equipment numbering system agreed on and used in design.
13 Operating, maintenance instructions, parts lists made available to operating personnel before plant starts.
14 Adequate quiet space for office and meeting areas.
15 Adequate locker rooms with plan for future needs worked out.
16 Safe supply of drinking water throughout plant.
17 Adequate, convenient space for shop and maintenance needs.
18 Shop and shelving layout built before plant starts.
19 All equipment spare parts to be delivered before plant starts.

Fuel Handling, Storage and Preparation

1 Drips on low points of gas lines.
2 L-p gas lines run level in solid ground, or are carefully graded and drained to avoid pockets cutting off gas flow.
3 Main gas-line shutoff valve on outside of boilerhouse.
4 Gage line for incoming gas-pressure run to control room.
5 Means for recording gas flow, temperature, specific gravity, Btu provided by gas supplier or in plant design.
6 Small-capacity regulator for gas supply at light loads.
7 Means to heat regulators if pressure drop is more than 5:1.
8 Feeler line for gas regulator runs downstream to give steady pressure at most essential point.
9 Bypass valve around gas-control valve.
10 Gas-control valve and main bypass operable from control board.
11 Small bypass valve around gas-control valve operable from burners for lighting off.
12 Burner header of ample size to reduce velocity effects.
13 Both ends of burner supply header vented.
14 Test pressure taps at header inlet, both ends of header and inlet to individual burners.
15 Oil-tank heaters of ample size with unrestricted flow areas, thermostatically controlled.
16 Tracer heating lines for oil lines in cold climates.
17 Means for gaging storage and oil tanks.
18 Facilities for unloading daily full-load fuel in 8 hours.
19 Methods for moving oil and coal cars.
20 Coal-car trackage reduces interference from unloaded cars.
21 Economical arrangements for moving fuel to or from storage.
22 Adequate area for present and future coal storage.
23 Coal preparation and handling arranged for minimum dust.
24 Coal supply, handling, milling equipment interlocked for safety.
25 Coal bunker and chutes arranged for free flow of wet coal.
26 Drier and pulverizer capacity to handle maximum wet, hard coal.
27 Pulverized fuel piping for good distribution and minimum settling out.
28 Space and layout for fuel sampling, preparation, testing.

Water and Water Treatment

1 Keep wells far apart, minimizing water table drawdown.
2 Water-depth gage lines for wells.
3 Supports for discharge lines near pumps.
4 Settling-basin level control for at least one pump.
5 Level gages in settling basin.
6 Sumps for draining and cleaning settling basin.
7 Pump outlet from settling basin set few inches above bottom.
8 Elevated-tank level indicator visible from plant.
9 High- and low-level alarms for elevated tank.
10 Altitude valve for elevated tank.
11 Elevated-tank overflow piped so tank may be overflowed continuously during winter.
12 Service-water pump head at full load only slightly above elevated-tank static head.
13 Water meters ahead of zeolite softeners.
14 Check valve to prevent hot water reaching zeolite material.
15 Representative samples of water obtained at earliest date.
16 Minimum water-treatment equipment installed initially with provision for later amplification if needed.
17 Minimum chlorination equipment.
18 Water-testing apparatus, chemicals ordered for early delivery.
19 Ample space for water apparatus storage and use.
20 Provide for convenient truck, railroad delivery of chemicals.
21 Ample space for dry storage of chemicals.
22 Platforms or hoists for easy chemical handling.
23 Hose connection, floor sumps to clean chemical use areas.
24 Zeolite material suitable for incoming water condition.
25 Chemical feed tank, pumps to supply chemicals to boiler or boiler feedwater.
26 Phosphate feed direct to boiler drums.
27 Safe handling, good distribution by acid feed system.
28 Gage boards or scales to show condensate storage-tank contents in thousands of pounds.
29 Cooling coils and layout for steam and hot-water samples.

Circulating-Water System

1 Log boom at intake to keep floating trash away.
2 Intake equipment of corrosion-resistant materials or finish.
3 Traveling screens and auxiliaries installed where needed.
4 Ample screen area, screens in series for dirty water.
5 Means for safely cleaning and washing screens.
6 Necessary equipment for screen hoisting.
7 Stop logs or other method for complete rapid unwatering of circulating-water tunnels.
8 Intake screens and racks removable for repair and inspection.
9 Screen chamber and circulating-water tunnels avoid sudden turns to minimize eddies.
10 Pump suction pipes carried fairly close to tunnel bottom.
11 Circulating pump-suction piping arranged to avoid air pockets, spins or uneven distribution to pump inlet.
12 Circulating pumps to be self-priming where feasible.
13 Motor-operated or butterfly valves for pump, condenser piping.
14 Rubber expansion joints for pipe and condenser expansion.
15 Check valve or other means to prevent pump reversal with cooling tower or parallel pump installation.
16 Cooling tower separated to minimize recirculation.
17 Tower location minimizes traffic, plant hazards from fog, spray.
18 Towers have best aspect to warm-weather winds.
19 Tower approach and water capacity sized with condenser for best over-all economy.
20 Tower makeup inlet where cool incoming water does most good.
21 Tower blowdown easily observed, measured by weir.
22 Tower overflow adequate in size and non-siphoning.
23 Convenient method for regulating water to tower sections.
24 Tower basin volume equals 8 to 12 hr normal evaporation.
25 Tower basin sloped to drain to clean-out sump for easy drainage and cleaning.
26 Tower basin constructed to be essentially leakproof.

Condenser and Auxiliaries

1 Most economical condenser design for water supply available.
2 Condenser tubes arranged to avoid subcooling of condensate.
3 Divided waterbox or backwashing method if needed.
4 Room for condenser tube removal.
5 Means for handling waterbox covers.
6 Waterboxes without air pockets or turbulence-producing corners.
7 Waterbox drain valves adequate in size.

MORE ON NEXT PAGE

8 Convenient access to condenser waterboxes.
9 Guards over circulating-water pipe connection if needed for safety in waterboxes.
10 Proper tube alloy to resist water conditions.
11 Tube sheet of about same material as tubes.
12 Tube inlets streamlined.
13 Enough tube support sheets with rounded-edge tube holes.
14 Incoming drains and recirculating nozzles arranged to cool water and avoid tube impingement.
15 ASME pressure-test connection at condenser-exhaust neck inlet.
16 Test thermometer well at condenser-exhaust neck inlet.
17 Special test thermometer wells and pressure taps at inlet and outlet circulating-water lines.
18 Support blocks and maximum allowable water load specified.
19 Priming jet or high-level vent pipe for condenser waterboxes.
20 Adequately sized hogging jet at 50% steam pressure for steam space evacuation.
21 Muffler on hogging jet outlet if nuisance possibility.
22 Steam-jet air pump (sjap) operating pressure not over 80% of normal steam pressure in station.
23 Enlarged section, makeup-water connection and long gage glass on sjap intercondenser drain loop section.
24 Recirculating line for cooling sjap condenser at low loads, this line taken off before hotwell level-control valve.
25 Hotwell level-control valve well balanced with large float or pilot operated.
26 Hotwell high-water alarm.
27 Condensate pumps set low enough to give needed suction head.
28 Condensate-pump pure sealing-water supply always available.
29 Condensate pumps vented to condenser if necessary.

Turbine-Generator Unit

1 Surface protection specified for oil tank and accessible piping.
2 Oil lines kept away from hot pipes and surfaces.
3 Indication of oil leaving bearing, recording of oil and water temperatures leaving oil coolers.
4 Oil gages and sight overflows valved and protected so they are readily seen but not easily broken, arranged so vacuum in oil reservoir will not affect accuracy.
5 Throw rings or other arrangement on turbine shaft to prevent contaminating oil with sealing water.
6 Bypass around oil-tank vapor extractor.
7 Trapped separator on vapor-extractor vent line or line run to location where oil and fumes are not objectionable.
8 Emergency electric-driven oil pump to supplement steam-driven oil pump in case of steam failure.
9 Oil- or air-operated check valves to prevent entry of steam into turbine from heaters.
10 Indication of steam pressure, vacuum, speed and throttle valve position readily seen from turbine-starting-control position.
11 Throttle trip for low-vacuum condition.
12 Indication or ready observation of throttle-valve position from front of turbine.
13 Relief valve or diaphragm for exhaust atmospheric relief.
14 Atmospheric-relief vent piped to outside of turbine room.
15 Automatic control of sealing-steam pressure.
16 Gland seal tank at maker's specified elevation with adequately sized supply and drain lines, and high- and low-water alarms.
17 Thermometers and gages located for convenient observation.
18 Pockets for hydrogen leakage accumulation avoided or vented.
19 No water or oil lines in generator air or hydrogen ducts.
20 Observation ports and indicators to detect water or oil leakage in generator.
21 Room for generator-rotor removal.
22 Turbine-room crane capacity adequate to handle present and future machine parts during overhaul.
23 Room for storage of machine parts during overhaul.
24 Coolest water available used for generator cooling.
25 Coolers arranged for minimum vacuum, air-binding prevention.
26 Coolers arranged so entire load need not be lost in event of a cooler section outage.
27 Individual outlet valves and thermometer wells for each cooler section.
28 Small bypass valve for water control during cold weather.
29 Master water-control valve and bypass arranged for convenient operation near indication of generator hydrogen and air temp.
30 Indication of gas temperature in and out of generator coolers.
31 Connections for hydrogen and CO_2 bottles specified to fit available containers.
32 Hydrogen control panel made weatherproof if located outdoors.

Steam-Generator Unit

1 Adequate steam-release area and other methods in boiler drum to generate pure steam.
2 Adequate furnace volume for fuels to be burned.
3 Consideration given to possible future fuels to be burned.
4 Sufficient draft for maximum load under unfavorable conditions.
5 Duct arrangement for even fuel-air supply to all burners.
6 Safety valves enclosed to protect against or designed to withstand effects of rain and wind.
7 Power-control valve (supplementary electrically-controlled safety valve) capacity not over 20% of maximum steam capacity.
8 Joints above and below power-control shutoff valve designed for temperature changes.
9 Drum test-gage connection for setting safety valves.
10 Continuous blowdown line taken from most concentrated water location in boiler.
11 Burners set close to and fronting main operating area.
12 Burner platforms arranged for easy insertion of torches and inspection of fires.
13 Furnace doors at side and rear of furnace to see burners.
14 Convenient access to furnace for inspections.
15 Enough doors, manholes for access to all steam-generator parts.
16 Convenient access to boiler doors and manholes.
17 Convenient access to all valves, controls on steam generator.
18 Fuel-air controls conveniently adjacent to each burner.
19 Manual controls and instruments at boiler burners for 1-man starting.
20 Water columns visible from boiler front and control room.
21 Drum pressure gages at boiler front and in control room.
22 Fuel shutoff in case of loss of forced- or induced-draft fan or low fuel pressure.
23 Three-way gas cock located next to boiler, 2-way cock next to pressure regulator.
24 Supply of stopcock grease and operating handles ordered for start of operation.
25 Oil lighting torches provided for each pulverized-fuel burner.
26 Oil-torch fuel tank large enough to handle tank truck delivery.
27 Representative steam sampling at superheater inlet and outlet.
28 Representative flue-gas sampling for boiler, economizer, air-preheater outlets.
29 Representative temperature indication for boiler, economizer, preheater outlets.
30 Screens for forced-draft fan inlet openings.
31 Flue-gas ducts from induced-draft fan to stack insulated to prevent condensation.

Piping

1 Systems designed for maximum normal pressure, temperature.
2 Materials specified to endure expected temperature and corrosive conditions.
3 Piping sized for best over-all economy with allowance for future expansion.
4 Sectionalizing or root valves to avoid complete plant shutdown.
5 Provision made for expansion from temperature changes.
6 Pipe hangers carry pipe safely, avoid strain on machinery.
7 Adequate headroom, minimum passageway interference by piping.
8 Piping runs checked for interference with conduits, steelwork.
9 Valve design specified to endure expected service conditions.
10 Valves may be repacked while under pressure.
11 Bypasses on valves 10 in. and larger for 200 psig and above.
12 Valve operators on large valves frequently operated.
13 Smaller, frequently operated valves conveniently located or fitted with chain wheels or extension stems.
14 Unnecessary pockets and water traps in piping avoided.

15 Drains for cold plant start-up, to cut any equipment into service with a hot plant or to put plant away cold.
16 Traps on saturated-steam lines at low points.
17 Traps on superheated-steam lines normally shut down, but which must be started quickly or automatically.
18 Frequently used high-pressure drains double valved.
19 Heater-drainer valves near discharge end of drain line and line thereafter enlarged, made heavier, otherwise protected against steam-water erosion.
20 Drains on shell and exhaust line of auxiliary turbines.
21 Backing rings or other methods specified for keeping slag out of pipelines.
22 Careful cleaning and inspection of pipes, joints specified.
23 Water-tight hydrostatic test on all lines before placing in service specified.
24 Steel plugs for closing unused or test openings in pipelines and equipment.
25 Retightening of all gasketed joints while hot specified.
26 Safety-valve capacity equal to maximum steam quantity to be relieved.
27 Easy access and operation for reducing stations, safety valves.
28 Safety-valve relieving pressures correspond to maximum, safe working pressures.
29 Safety-valve discharge piping guided to prevent contact with valve when hot.
30 Safety-valve discharge lines joined at an angle to prevent steam blowback if individual vent lines are too long.
31 Drains on safety-valve dishells and above valve seat drain.
32 Safety-valve drains, if joined, join below lowest valve and each branch has check valve in the line.
33 Bypass and shutoff valves on both sides of reducing valve.
34 Shutoff and bypass valves same size as reducing valve or regulating valve.
35 Desuperheating equipment purchased for maximum possible water atomization.
36 Desuperheater control element located 50 to 100 ft from desuperheater, and in line enlargement if necessary.
37 Desuperheater as far from equipment served as possible.
38 Large collecting pockets, separators and traps following desuperheater if needed to protect equipment against faulty operating results.
39 Sharp piping bends close after desuperheaters or heater drainer valves avoided.
40 Relief valves of proper pressure and capacity on auxiliary turbine exhaust lines.
41 Relief valves on very long water lines next to pump discharge check valve to prevent pressure buildup when pump stops.
42 Copper expansion joints in bleed lines inside condenser protected against water erosion.
43 Dead ends avoided; exposed water piping, instrument lines and piping without normal flow protected from freezing by heavy insulation or tracing with electric-heating cable.

Pumps, Heaters, Miscellaneous Equipment

1 Heaters sized for normal maximum load, pressure and temperature.
2 Heaters and relief valves specified suitable for maximum steam and water pressures to be expected.
3 Room and facilities for removing heater tube bundles.
4 Relief valve for deaerator with maximum pressure and relieving capacity.
5 Automatic overflow for deaerator, but arranged so tank cannot be drained.
6 Means for continuing deaeration at low station loads.
7 Evaporator vapor brought in separately near top of deaerator.
8 Arrangements to maintain pressure, temperature, adequate suction head on feed pumps.
9 Suction strainers for preliminary use on boiler feed pumps.
10 Pump material and design to give long life, good efficiency.
11 Automatic recirculation for large boiler-feed pump protection.
12 Pumps running under vacuum or dirty water conditions equipped with lantern rings or stuffing boxes.
13 Conductivity cells for evaporator shell and vapor recording.
14 Clean water at high enough pressure for continuous supply to lantern rings.
15 Continuous blowdown line with control valve for evaporator and boilers.
16 Evaporator equipped with powerful well-balanced float valve or a pilot-operated valve for controlling water feed.
17 Ample blowdown tanks located and connected so drains or vents do not cause nuisance in sewers or adjacent plants.

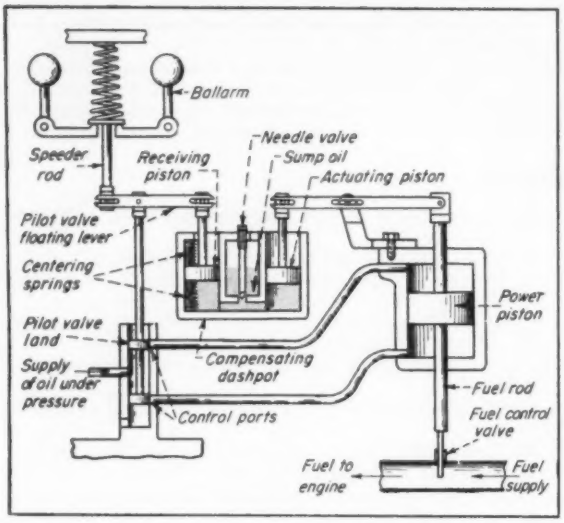
Electrical

1 Agreement reached with operators on relaying and protection for auxiliary motors.
2 Protection against surge transmission into plant.
3 Temperature and other alarm contacts uniformly specified to be normally closed.
4 Small auxiliary motors will stay in or reclose on short-duration interruptions or low voltages.
5 Large auxiliary motors will alarm on overload, trip only on short circuit.
6 Equipment start-stop buttons have guards to prevent accidental operation.
7 Emergency stop buttons near equipment if normal control for important auxiliaries is from control room.
8 Equipment start-stop buttons lettered or numbered so equipment controlled is plainly indicated.
9 Controls and instruments on switchboard plainly named.
10 Annunciator drops labeled with equipment name easily seen.
11 Potential transformers outside plant or in isolated room.
12 Automatic throwover from ac, dc or other service for essential service including emergency lighting, instruments and communication system.
13 Agreement reached with operators on communication system.
14 Communication system specified to be in service before plant is placed in operation.
15 Special voltage or special type signal lamps avoided.
16 440-v terminals protected or marked when exposed behind gage boards or elsewhere.
17 High- and low-level alarms where wrong level causes trouble.
18 Wattmeters or test connections on panels of switches serving major plant auxiliaries.
19 Conduit runs, junction boxes, etc, checked for interference with mechanical and structural features.
20 Motors, conduit, junction boxes, switches and all other electrical equipment, exposed to outdoor moisture and dust, properly designed for troublefree operation.
21 Guards or screens for open motor ends.
22 Drain pits to catch transformer oil spillage.

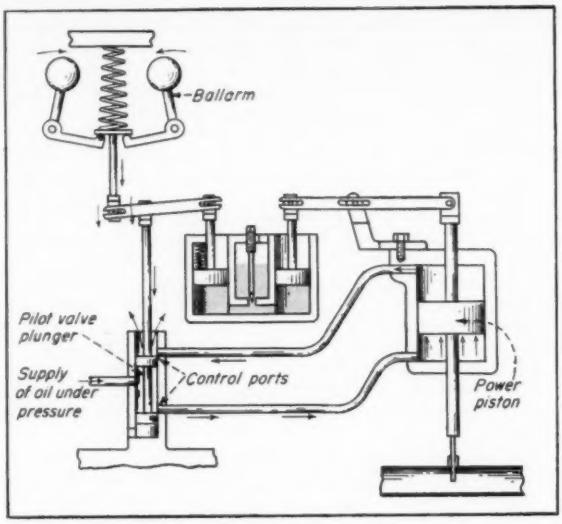
Instruments and Control

1 Indicating thermometers and pressure gages for all readings normally logged.
2 Recording instruments for most important flows, pressures, temperatures, conductivities.
3 Boiler steam temperature instrument: continuous recording type.
4 Pressure gages for boiler front and for control room.
5 Master-firing gage on header or near turbine for control room and combustion-control system.
6 Pressure gage for suction and discharge of each main pump.
7 Test wells or taps to check recording thermometers or pressure gages.
8 Thermometer wells specified of materials and design to withstand temperatures and pressures to be encountered.
9 Test taps and openings specified for main units of equipment.
10 Spare test wells on hand.
11 Set of test gages, gage tester, supply of glass thermometers, glass tubing, rubber tubing, corks, potentiometers, thermocouple wire on hand.
12 Special test instruments specified to be furnished by manufacturer of equipment to be tested.
13 Meter orifices located in horizontal runs, above meter with good accessibility, adequate straight runs before orifices.
14 Orifice taps far enough from flanges to avoid bolt interference.
15 Flowmeter and pressure-gage lines should be sloped and grouped for economical freezeproofing, where needed.

(*Continued on page* 238)



1 Arrangement of the parts of an isochronous hydraulic governor. Note the actuating, receiving and power pistons



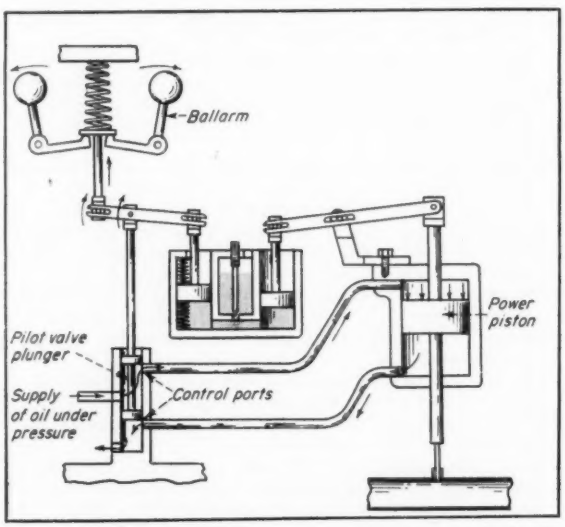
2 First effect of load increase on an isochronous hydraulic governor. Ballarms move in and lower pilot-valve plunger

DIESEL GOVERNORS—IV

Isochronous Hydraulic Governors For Exact Engine Speed Control

Temporary speed droop prevents over-correction of fuel flow, permits maintaining engine at exactly constant speed without hunting

By **EDGAR J KATES**, *Consulting Engineer, New York, N. Y.*



5 First effect of load decrease on isochronous hydraulic governor. Ballarms move out and lift pilot-valve plunger

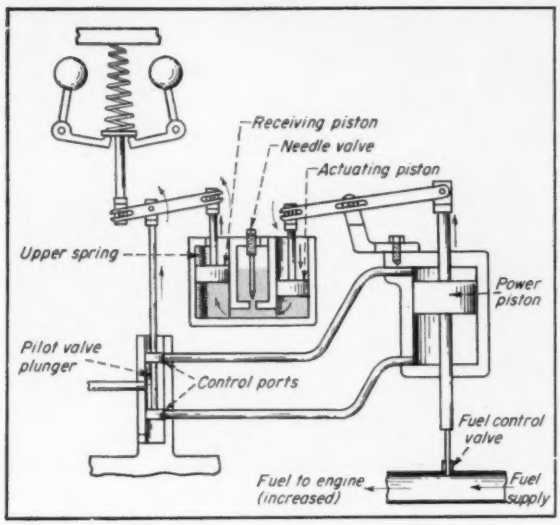
► HYDRAULIC GOVERNOR, described in May POWER, pp 98-100, cannot maintain engine at exactly constant speed regardless of load because it employs permanent speed droop to prevent hunting. In other words, it is not isochronous.

An isochronous hydraulic governor maintains exactly constant speed without hunting. It does this by employing temporary speed droop to give stability while fuel flow is being corrected, and then gradually removing the droop as engine reacts to fuel correction and returns to its original speed. Use of temporary speed droop to prevent overcorrection of fuel is called *compensation*.

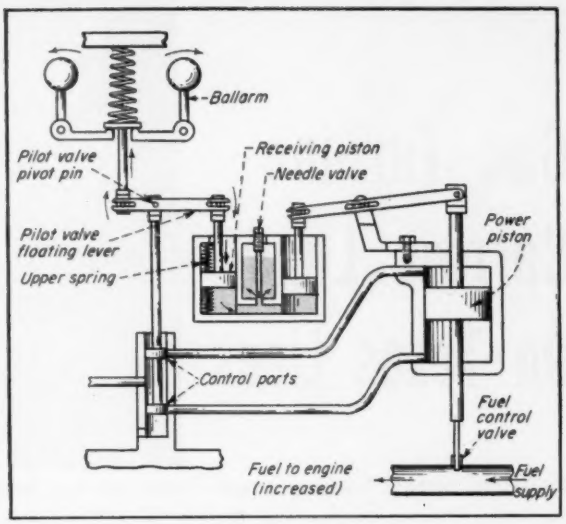
Compensation requires two actions: (1) a droop applicator, as fuel flow is changed (2) a droop remover as engine responds to fuel change and returns to its original speed.

These actions can be accomplished by a combination of two hydraulic pistons and a needle valve. Droop action is applied by the two pistons, which are connected by an oil passage. Droop is removed by allowing oil to escape from the connecting passage through the needle valve. The oil goes to a sump after leaving passage. Centering springs return the droop-applying piston to its original position.

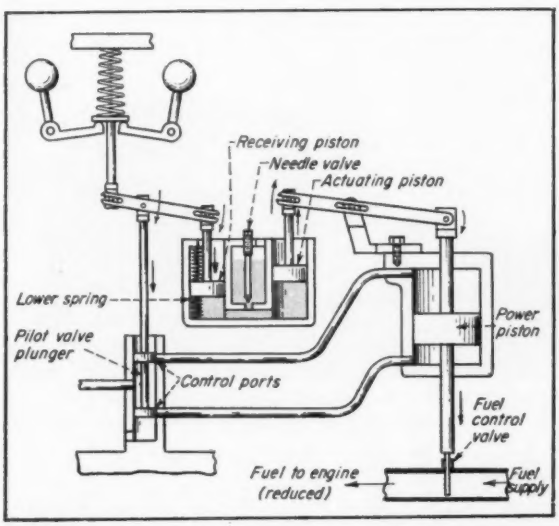
Parts needed in a governor to apply and remove temporary speed droop (compensation) are shown in Fig. 1. These are: (1) a transmitting or *actuating piston* to transfer motion of fuel-changing mechanism to (2) a spring-loaded responding or *receiving piston*, which acts on parts of the governor to cause speed droop, and (3) an adjustable needle valve in the connecting oil passage of the two pistons, which



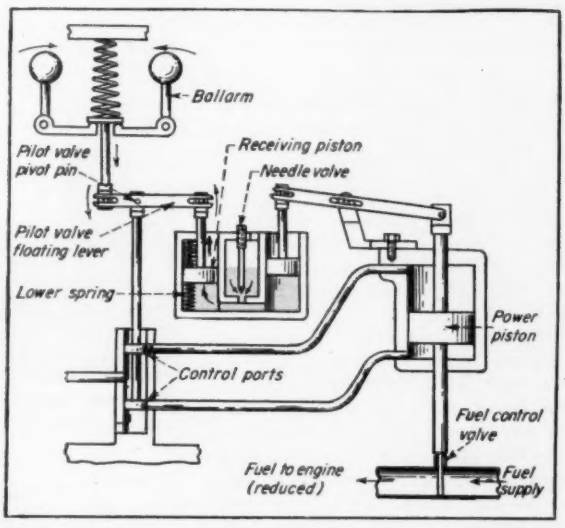
3 Second effect of load increase on isochronous governor. Power piston moves up, recenters pilot-valve plunger



4 Final effect of load increase on governor. As speed of engine rises to normal, ballarms become vertical again



6 Second effect of load decrease on isochronous governor. Power piston moves down, recenters pilot-valve plunger



7 Final effect of load decrease on governor. As speed of engine falls to normal, ballarms become vertical again

allows oil to leak off to governor sump.

Load Steady. With engine running at normal speed under steady load the ballarms are vertical and pilot-valve floating lever is horizontal, Fig. 1. Control ports in pilot-valve bushing are covered by lands on pilot-valve plunger. Receiving compensating piston is in normal position. Power piston and fuel rod are stationary. Position shown corresponds to about one-half fuel.

Load Increase. When load is applied to engine its speed decreases, Fig. 2. Ballarms move in, lowering pilot-valve plunger to admit oil pressure under power piston. Oil pressure moves power piston up, Fig. 3. This pushes actuating piston down, which displaces oil to the receiving piston, forcing this piston up to compress upper spring and lift pilot-valve plunger. Plunger lands close the control ports to stop further movement of power piston.

This action is rapid, and the small opening of the needle valve prevents appreciable leakage. Therefore, oil displaced by the actuating piston causes a corresponding movement of the receiving piston.

As power piston moves up it increases fuel supply to bring engine speed back to normal. As engine responds to the fuel change, its speed gradually returns to the original, and the ballarms gradually resume their vertical position. At the same time, the upper spring starts pushing the receiving piston down to its normal position and the floating lever tilts about the pilot-valve pivot pin.

Rate at which receiving piston moves down is determined by needle-valve opening, which is adjustable. If opening is correct, rate of return of re-

(*Continued on page 232*)

Gas Turbine Carries Load On Texas Lines

Regional utility finds gas turbine does excellent job in backing up transmission line and on peaking service*

► In May 1952, Texas Power & Light Co placed its first gas turbine in service in its Dixon Street Station at Gainesville, Tex. The 3500-kw, regenerative, 2-shaft unit drives a 5000-kva generator. The gas turbine was installed in parallel with a 1000-kw dual-fuel internal-combustion engine.

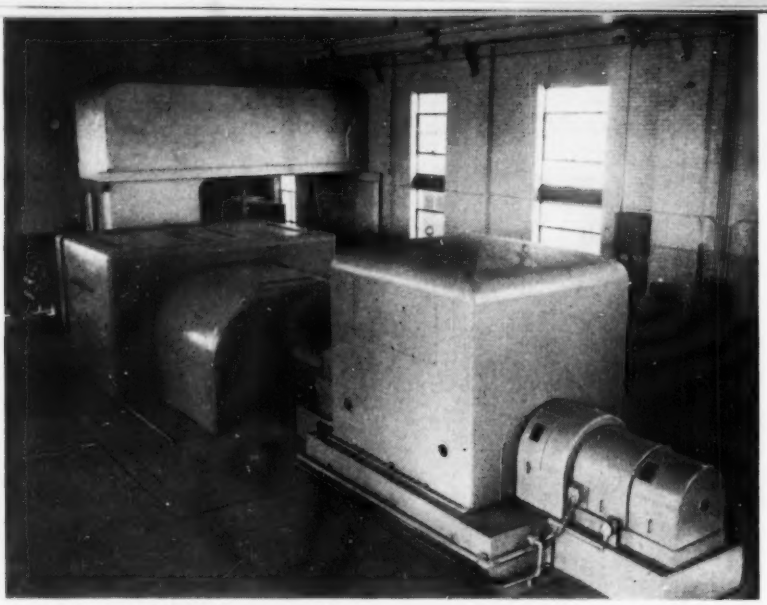
These units were selected after an exhaustive economic study comparing various types and sizes of steam units, internal-combustion engines and gas turbines. With the station completed, the investment proved to be very close to the estimate, and fuel consumption less than expected. Other costs and factors fell close in line with the estimate.

The gas turbine has run over 1100 hours, being used almost daily for peaking service. Both units can be started quickly in transmission-line failure. It has been the practice to run the gas turbine when ice storms are expected. With a thermal efficiency over 23% (based on HHV of gas) the gas turbine competes with the system steam plants, considering the remoteness of Gainesville and unavoidable transmission-line losses.

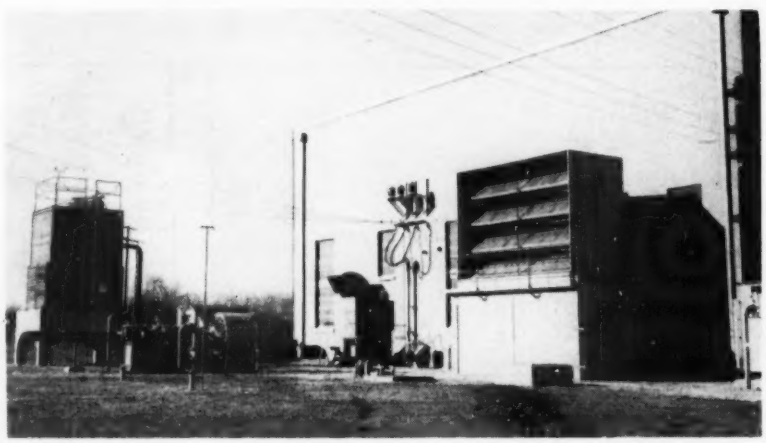
The 2-shaft unit has both turbine wheels in one casing. The single-stage high-pressure turbine drives the only 14-stage axial-flow compressor, while the single-stage low-pressure turbine drives

(*Continued on page* 230)

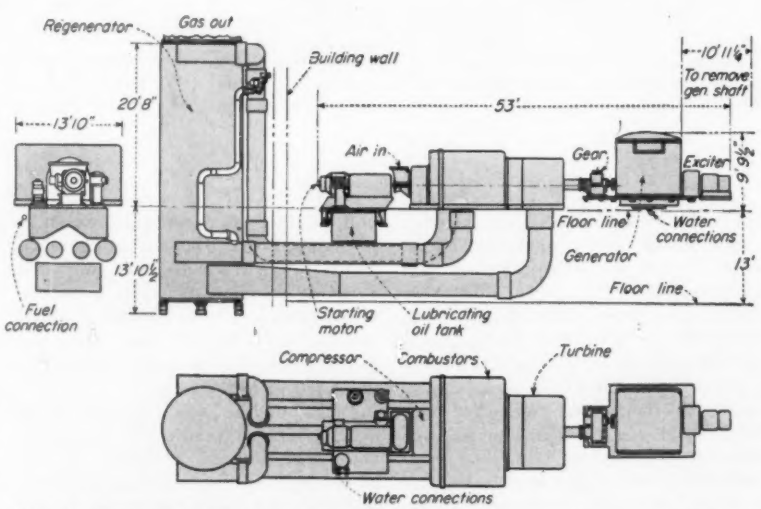
*Abstracted from "Regenerative Gas Turbine-Generator for Central Station Service," by H C Davis, Texas Power & Light Co, and R L Jackson, General Electric Co. Read before American Power Conference, Chicago, March 25-27, 1953.



3500-KW GAS TURBINE drives 5000-kva generator. Two-shaft unit has both turbine wheels in one casing, regenerator outside building wall, *left;* one compressor



COOLING TOWER, *left,* handles water for oil and turbine cooling, fuel-gas compressor pressurizes to 160 psig, evaporative inlet cooler, *right,* raises unit capacity



HOT AIR AND GAS DUCTS run under operating floor connecting gas turbine unit and outdoor regenerator. Combustors ahead of turbine are housed under large cover

a **Power** handbook

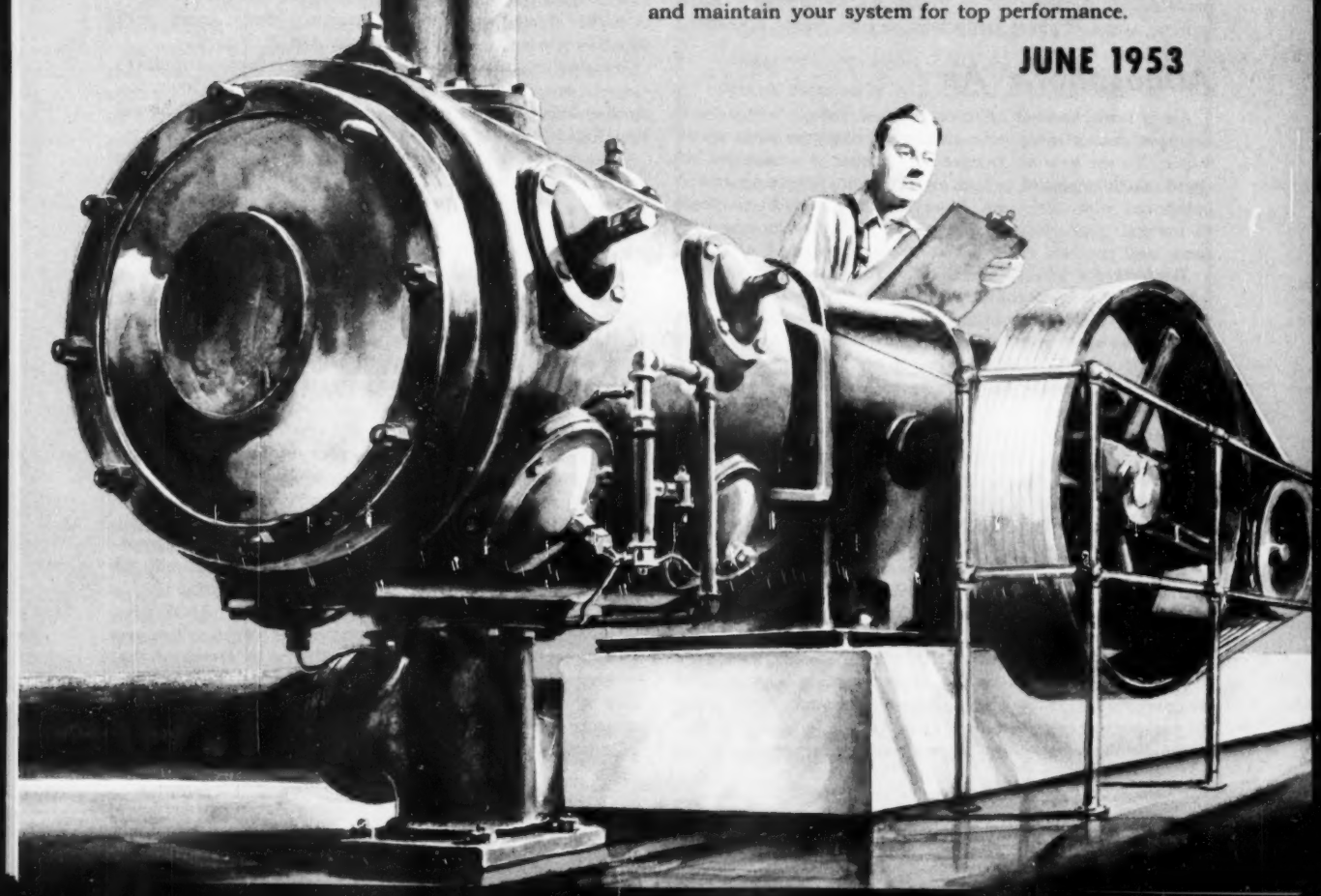
Compressing Air

By TYLER HICKS, *Associate Editor*

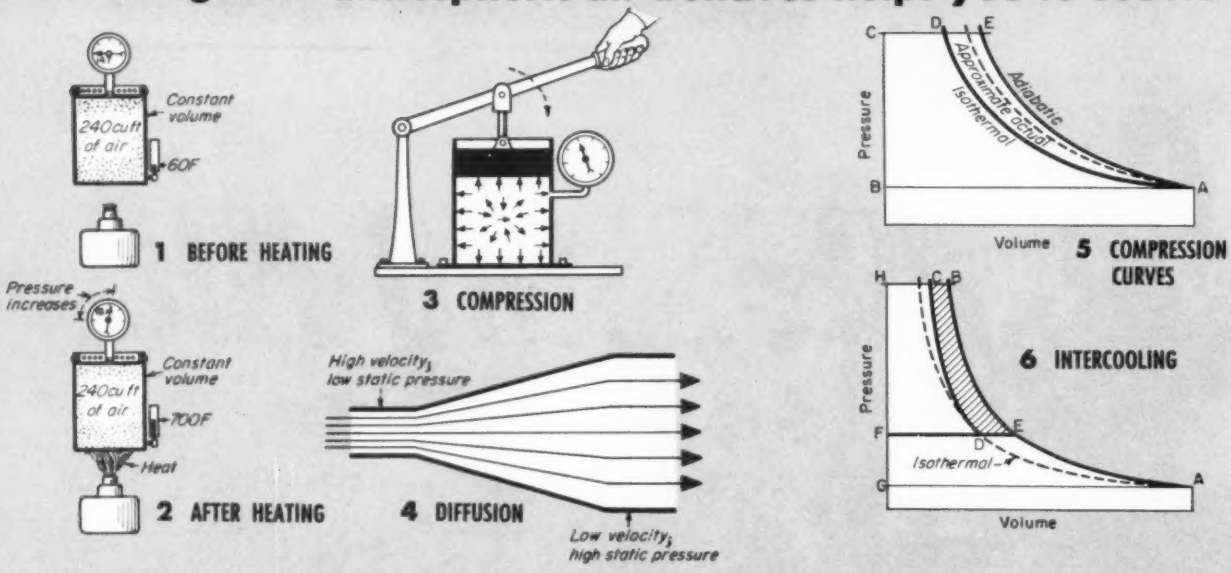
Compressed air powers a growing array of tools and devices, operates delicate instruments, agitates and atomizes liquids, blows soot, conveys materials. And it takes on new jobs every day.

It's hard to find a plant where this versatile power service isn't put to good use, an engineer who doesn't have responsibility for an air system — large or small. So here, for all POWER readers, is a handbook covering the compressors that take in atmospheric air and give it the pressure boost that makes it useful, the auxiliaries needed for good compressor operation, the distribution system that puts air to work throughout the industrial plant. Use it to select and lay out equipment, operate and maintain your system for top performance.

JUNE 1953



Knowing how atmospheric air behaves helps you to see...



PROPERTIES OF ATMOSPHERIC AIR are familiar to anyone who has ever inflated an auto tire with a hand pump. Shown here are some of the effects air properties exert on compressor operation. They help you understand plant air applications

How Compressors Work

Air compressors have but one diet – atmospheric air. So performance depends on its properties. Let's take a quick look at some of them important to compressor operation.

Atmospheric Air

Air is a mechanical mixture of gases, mainly oxygen and nitrogen. And atmospheric air always contains some water vapor. To see how air behaves, remember it consists of individual molecules of oxygen and nitrogen, widely separated compared with their size. Always traveling at high speed, at normal temperatures, they strike against enclosing surfaces and produce what we know as pressure, Fig. 1.

Temperature affects average molecule speed. When we add heat to a fixed volume of air, Fig. 2, molecules travel faster. So they hit containing walls harder and oftener. This shows up as greater pressure.

Now if we take a fixed mass of air and squeeze it into less space, molecule travel is restricted. There's no speed change, but molecules hit walls with greater frequency. So pressure is greater.

If, instead of a slow squeeze, we compress air rapidly, temperature rises as well as pressure. The fast-moving piston delivers energy to the molecules just as a bat delivers energy to a baseball. Higher molecule speed results, and this always means higher temperature.

Compression efficiency is compared against two theoretical standards – *isothermal* and *adiabatic*. Neither occurs in an actual compressor because of unavoidable losses. Plot of compression process on a pressure-volume diagram, Fig. 5, shows an actual unit works between these two standards.

Isothermal compression has perfect cooling – air remains at inlet temperature while being compressed. Work input to compressor, measured by area *ABCD*, is least possible.

Adiabatic compression has no cooling; temperature rises steadily during compression. Discharge pressure is reached sooner than with isothermal compression. Since air pressure is higher during every part of piston's stroke, more work input is needed, as shown by area *ABCE*, Fig. 5.

Intercooling. If compression is divided into two (or more) steps or *stages*, air can be cooled between them. This *intercooling* brings actual compression line closer to isothermal line, Fig. 6. Area *BCDE* shows power saved.

Atmospheric air, as we saw, contains water vapor in varying quantities, depending on location, weather, etc. Since a compressor cannot separate moisture from its intake air, let's see how water vapor affects the air delivered.

Water vapor in atmospheric air exerts a pressure separate from that of the air alone. Total atmospheric pressure is the sum of the air pressure and the vapor pressure.

Suppose we have 80-F air saturated with water vapor. In this state, the air contains all the moisture it can hold at this temperature. Any added vapor would condense.

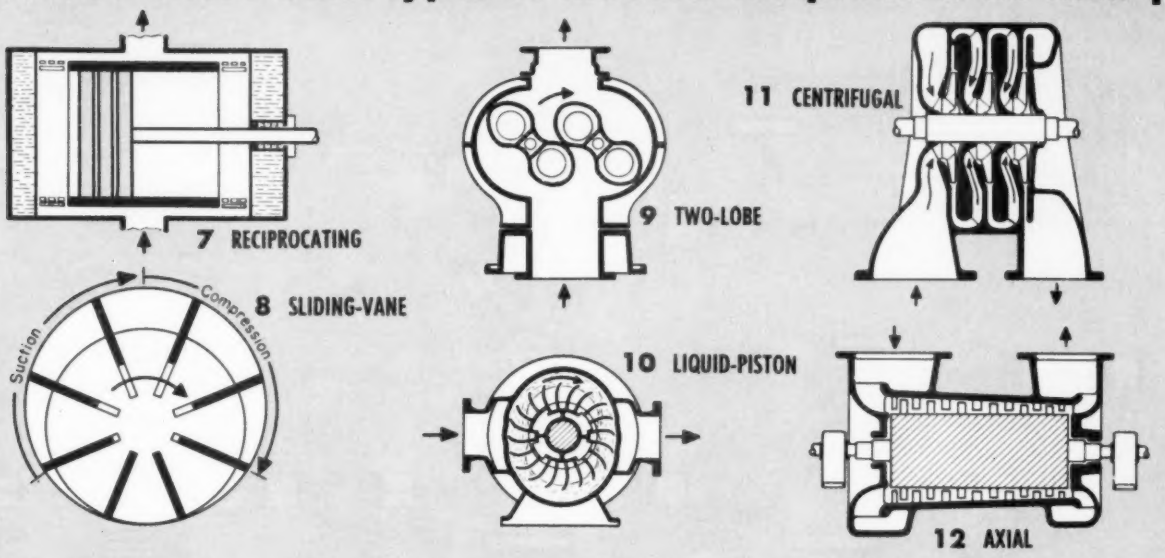
If total atmospheric pressure is 14.7 psia, pressure exerted by air alone must be the difference between 14.7 and vapor pressure at 80 F. Latter is same as saturated steam pressure at 80 F and shows in the steam tables as 0.507 psia. So air pressure is 14.7 – 0.507 = 14.19 psia.

Partially saturated air contains less than the maximum amount of water vapor that can be held. Amount of moisture is measured by *relative humidity*. If our 80-F atmospheric air has a relative humidity of 70% it holds only 0.7 as much water as it could. Vapor pressure is 0.7x0.507, or 0.355 psia. Air pressure is 14.7 – 0.355 = 14.35 psia.

Water vapor in air entering compressor leaves as a superheated vapor because its temperature is in excess of that corresponding to its pressure. It can be converted to water only by cooling to a temperature below the saturation temperature corresponding to its pressure.

Immediate cooling of air after it leaves the compressor

...how these basic types of modern compressors do their job



SIX COMPRESSOR TYPES diagrammed find many different uses in modern industry. Each has its advantages and gives best results on jobs where it suits the needs. Wise choice of compressor type is one of the keys to years of good performance

proves best, because this prevents vapor from reaching distribution system. Either air- or water-cooled heat exchangers, called *aftercoolers* (p 96), are used for this.

Modern Air Compressors

Each of the two major design classifications—*positive displacement* and *dynamic*—has its advantages.

In positive-displacement compressors, Fig. 7-10, successive volumes of air are confined within a closed space, and pressure is increased by reducing volume of space. Units of this type may be further classified as *reciprocating* or *rotary*, and these, in turn, subdivided by design features.

Reciprocating compressors, Fig. 7, suck air into cylinders through valves, during the *suction* stroke. At end of *discharge* stroke, air leaves at higher pressure. Separate valves are provided for inlet and outlet.

Sliding-vane rotary compressor, Fig. 8, traps air between vanes as rotor passes inlet opening. As rotor turns toward discharge port, volume of cell between any two vanes decreases. This causes air pressure to rise to rated discharge value. Vanes slide in and out of slots as rotor turns, are held against casing by centrifugal force.

Two-lobe rotary compressor, Fig. 9, has identical impellers held in a fixed relationship to each other by external gears. When impellers rotate, each traps air between its outer surface and the casing. When impeller upper tip passes top edge of casing it permits discharge to begin. Bottom tip of impeller pushes enclosed air into discharge piping, compressing it against the backpressure.

Liquid-piston rotary, Fig. 10, has a round multiblade rotor revolving in an elliptical casing partly filled with liquid, usually water. When rotor turns it carries liquid around with it, the blades forming a series of buckets. Because liquid follows casing contours, it alternately leaves and returns to the space between blades (twice each revolution). As liquid leaves bucket, air is drawn in. When liquid returns it compresses air to discharge pressure.

Dynamic compressors use rotating elements to accelerate air. By diffusing action, velocity is converted to static pressure. Fig. 4 shows basic idea. Total energy in a flowing air stream is constant. Entering an enlarged section, flow speed is reduced and some of velocity energy turns into pressure energy. Thus static pressure is higher in the enlarged section. Dynamic compressors include centrifugals, axials, and mixed-flow designs.

Centrifugal compressors, Fig. 11, usually take in air at impeller eye, accelerate it radially. Some static pressure rise occurs in impeller, but most is in diffuser section of casing, where velocity converts to static pressure.

Axial-flow compressors, Fig. 12, accelerate air in a direction generally parallel to the shaft. Units resemble turbines; each pair of moving and stationary blade-rows forms a stage. Pressure rise per stage is relatively small.

DEFINITIONS

FREE AIR is air at atmospheric conditions at any specific location. Since altitude, barometer and temperature may vary, this term does not mean air under uniform or standard conditions.

STANDARD AIR is air at 68 F with a pressure of 14.7 psia and a relative humidity of 36%. Gas industries usually consider 60-F air as standard.

DISPLACEMENT of a compressor is volume displaced per unit of time, usually stated in cubic feet per minute (cfm). Multistage compressor displacement is that of the low-pressure cylinder only.

CAPACITY is actual delivery in cfm of free air.

STATIC PRESSURE of air is measured so air velocity has no effect on the reading.

TOTAL PRESSURE is that produced by stopping a moving air stream.

VELOCITY PRESSURE is total pressure in a moving air stream, minus the static pressure.

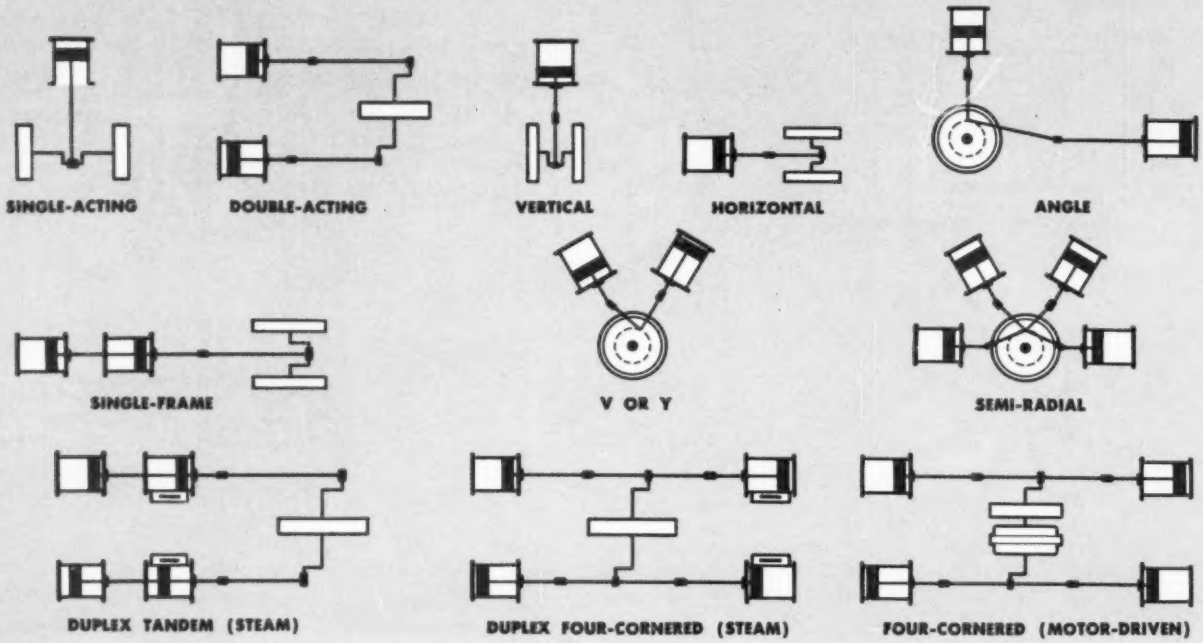
INLET PRESSURE is absolute total pressure of compressor inlet.

DISCHARGE PRESSURE is absolute total pressure at discharge.

INTERCOOLING is removal of heat from air between compressor stages or stage groups.

(Adapted from Compressed Air and Gas Institute definitions)

Some typical frame and cylinder arrangements used today



Reciprocating Types

Arrangement of reciprocating-compressor frames and cylinders varies with capacity, discharge pressure, intended service, drive, and other factors. Sketches above show many of the arrangements in use today.

Arrangements

Single-acting compressors use only one end of the cylinder to raise air pressure; *double-acting* units use both ends of the cylinder and discharge twice as much air per cylinder per revolution of the crankshaft.

Single-stage compressors raise air pressure from inlet to discharge on each working stroke of the piston in each cylinder. *Two-stage* units use one cylinder to compress air to an intermediate pressure and another to raise it to final discharge pressure. When more than two stages are used, the compressor is called a *multistage* unit.

Vertical compressors and *horizontal* units are arranged as shown. *Angle* type are multicylinder with one or more horizontal and vertical compressing elements. *Single-frame* (straight-line) units are horizontal or vertical, double-acting, with one or more cylinders in line with a single frame having one crankthrow, connecting rod and crosshead.

V or *Y type* are 2-cylinder, vertical, double-acting machines with cylinders at some angle with vertical, usually 45 deg. Single crank is used. *Semi-radial* compressors are similar to V or Y type but have horizontal double-acting cylinders on each side.

Duplex compressors have cylinders on two parallel frames connected through a common crankshaft. In *duplex-tandem steam-driven* units, steam cylinders are in line with air cylinders. *Duplex four-cornered steam-driven* compressors have one or more compressing cylinders on each end of frame and one or more steam cylinders on opposite end. In *four-cornered motor-driven* units, motor is on a shaft between compressor frames.

Elements

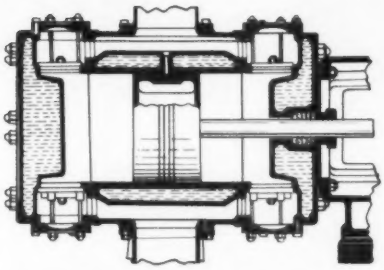
These are, briefly: (1) cylinders, heads, pistons, inlet and discharge valves (2) power-transmitting parts, including piston and connecting rods, crosshead, crankshaft, flywheel (3) lubrication system (4) cooling system (5) controls. First three groups are discussed on this and next three pages.

Cylinders. Drawings opposite show some typical designs. Valves may be in cylinder or in head. Water-cooled compressors have jacketed bores; air-cooled units have fins cast integral with cylinder. Cylinder material depends on discharge pressure: cast iron or steel up to 1000 psi, forged steel or alloys for higher pressures. Integral cylinder barrels permit at least one reboring without weakening walls.

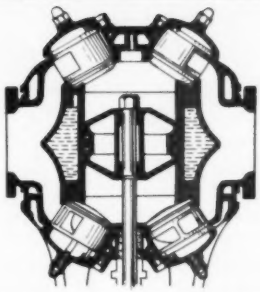
Pistons are usually semi-steel, close-grained cast iron, or aluminum. Trunk pistons, without crossheads, are used on single-acting compressors. Double-acting pistons are solid or hollow, with box or truncated shapes. Crosshead construction permits sealing compressing element nearer running gear. Packing to prevent air leakage along piston rod may be metallic, composition, carbon or fibrous, depending on service. "Oilless" compressors use carbon piston rings or liners, instead of metal, need no cylinder lubrication.

Valves of automatic type open and close on pressure difference. They consist of a plate, channel or strip with a seat and guard. Certain types are fitted with springs. Some designs of single-acting compressors have cam-operated poppet-type inlet valves.

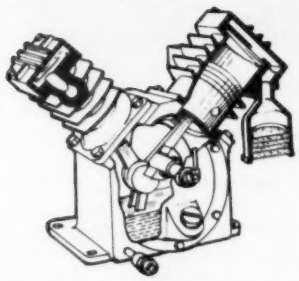
CYLINDERS AND JACKETS



HORIZONTAL compressor cylinder: triple walls, valves in head, jacket handholes

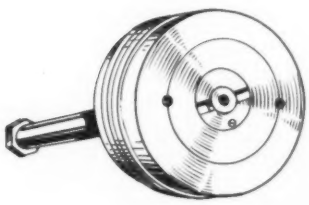


VERTICAL compressor cylinder with separate heads, water-cooled stuffing box



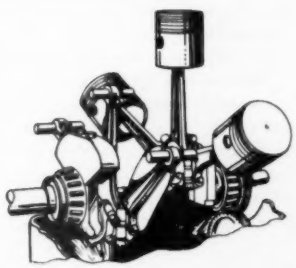
AIR-COOLED 2-stage compressor has fins on cylinders for greater radiating area

PISTONS AND RODS



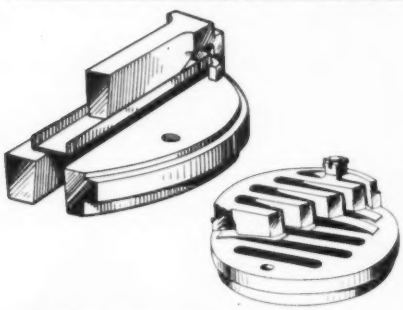
HOLLOW double-acting piston with lock on top, easily taken off rod for checks

STEEL piston rods here are press fits, secured by jamb nuts on top of piston



TRUNK pistons for 2-stage air-cooled compressor. Three run on one crank throw

SUCTION AND DISCHARGE VALVES



CHANNEL valve, *top*, has shaped elements; strip valve, *bottom*, flat ones

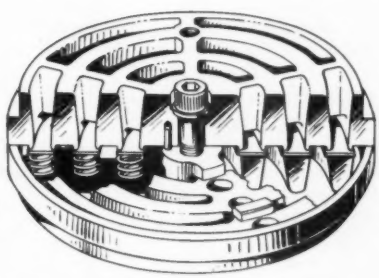
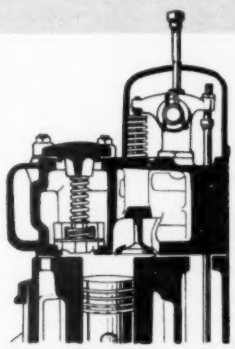
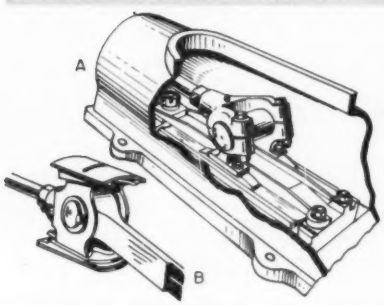


PLATE valve is fitted with cushioning springs to make sure plates seat gently

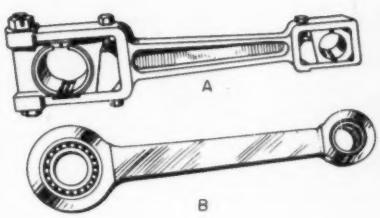


POPPET intake valve here is operated by a push rod and rocker arm from camshaft

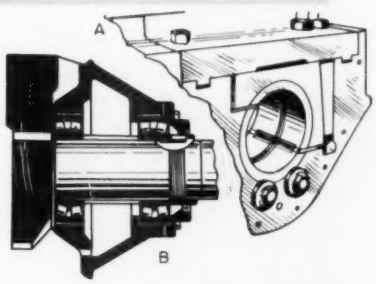
CROSSHEADS, CONNECTING RODS AND BEARINGS



SINGLE SHOE, at *A*, takes downward rod thrust. Other designs have two shoes, *B*



FORK-END connecting rod, *A*, has wedge adjuster. *B* has roller, needle bearings



SPLIT-BLOCK type, *A*, is wedge adjusted. *B* has double heavy-duty roller bearings

Stationary

Standard stationary compressors, intended for installation on more or less permanent foundations, are built in a number of types: (a) Vertical or V single-acting units, either air- or water-cooled, and single- or 2-stage, are available in sizes up to 150 hp. (b) Double-acting units, of vertical V, Y, semi-radial or right-angle types, and single-stage or multistage, come in 60-hp and larger sizes. They are water-cooled. (c) Double-acting units of single-frame type, horizontal or vertical, single-stage or multistage, range in size up to 125 hp, are water-cooled. (d) Duplex horizontal double-acting compressors, water-cooled and single-stage or multistage, run 75 hp and larger. Photos on these two pages show a few of typical designs available today.

Single-Acting. Fig. 1 and 2 show two examples of this design. Vertical unit, 1, mounts on its receiver, is air-cooled. Single-stage, its maximum pressure rating is 150 psi in the ¼- to 15-hp range. Two-stage air-cooled tank-mounted units are available for pressures to 200 psi.

Water-cooled unit, 2, has motor, compressor and radiator on a single base for direct mounting on plant floor. Pressure rating is 100 psi, capacity to 420 cfm at 100 psi.

Double-Acting. Right-angle crosshead-type 2-stage water-cooled unit, in Fig. 3, is rated at 80 to 125 psi with a displacement of 2397 cfm at 350 hp. Vertical V unit, Fig. 4, has a normal pressure rating to 125 psi and a displacement of 368 to 1828 cfm, depending on number of cylinders.

Single-frame units like that in Fig. 5 are built in a wide range of capacities for normal 100-psi plant service. Drive is usually an electric motor.

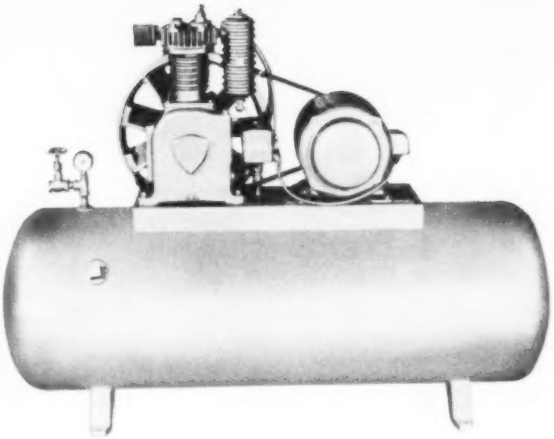
Duplex compressor, Fig. 6, offers capacities from 350 to 10,000 cfm, at pressures from 80 to 125 psi.

Other Types. In addition to types mentioned there are a number of other designs widely used for various jobs. Multistage, multicylinder, opposed units, Fig. 7, are built for pressures to 6000 psi, ratings to 5000 hp.

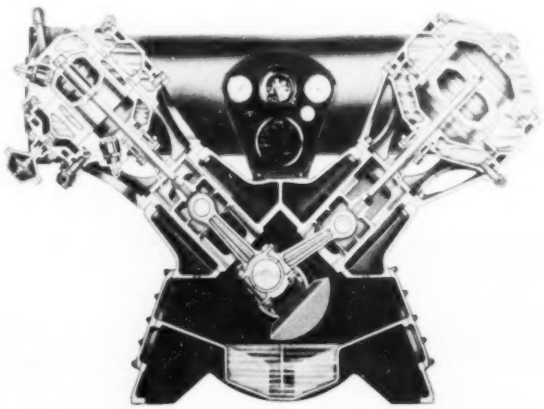
Oilless compressors, Fig. 8, are used where air free from oil is needed. Design shown has a carbon cylinder liner backed with steel. Piston rings are metallic. Compressor cylinder needs no lubricant. Other designs have a tail-rod and bearing to make piston free-floating; piston rings are made of carbon. Another construction has carbon pistons.

Engine-driven compressors, Fig. 9, have a vertical or V engine (gas or diesel) driving horizontal compressor pistons, in double-acting cylinders.

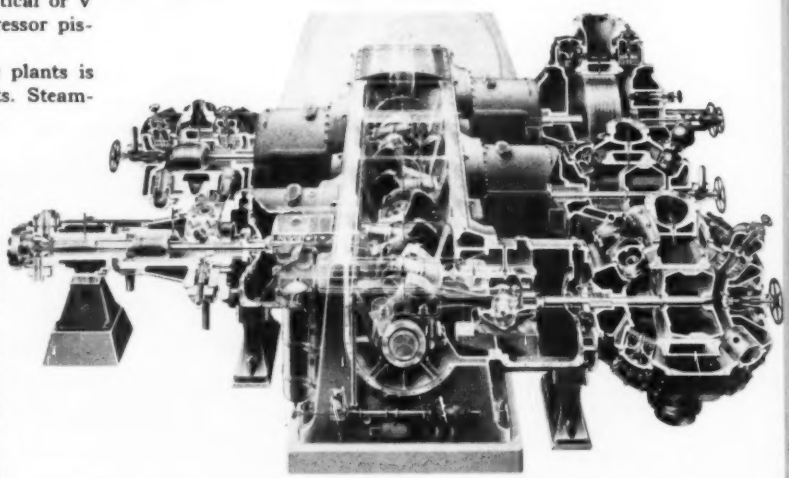
Another type of compressor popular in some plants is similar in design to locomotive air-brake units. Steam-driven, it mounts on wall, takes but little space.



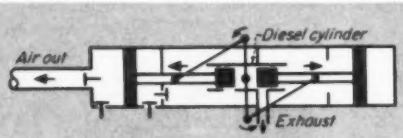
1 Single-stage single-acting air-cooled compressor, with a 150-psi pressure rating, ¼- to 15-hp range, is on receiver



4 Vertical V unit has two or four cylinders, depending on capacity desired. Pressures range to 125 psi, cfm to 1828

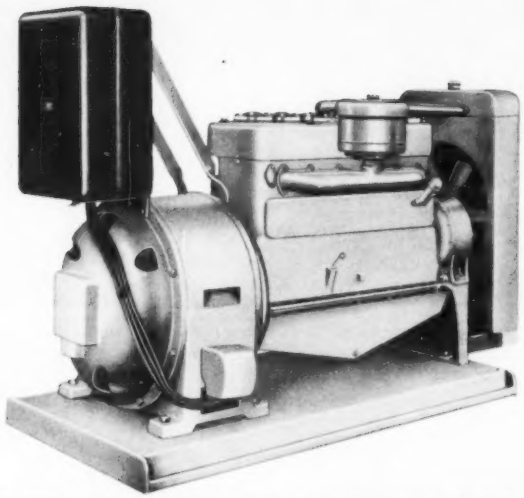


7 Multistage, multicylinder, opposed unit is built for pressures to 6000 psi. Other types also handle high pressures

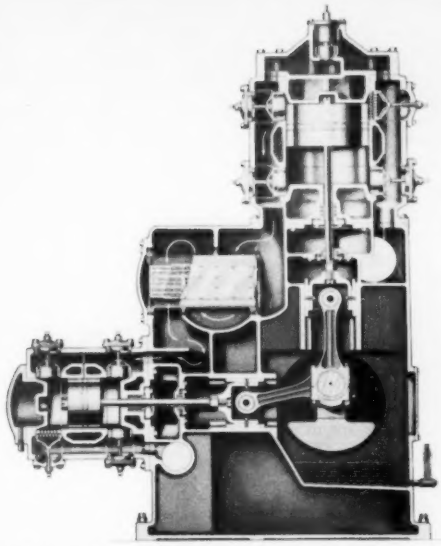


Free-Piston Compressors

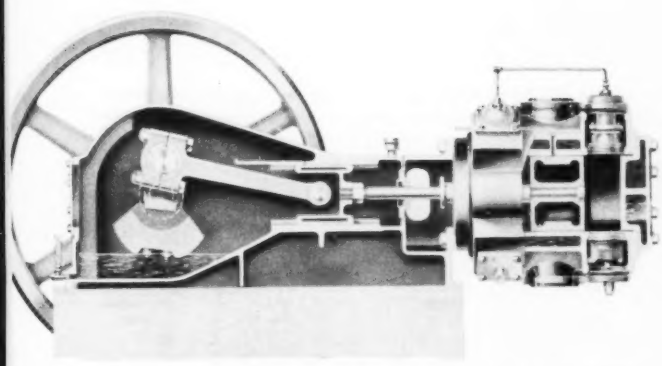
These compact, relatively vibration-free units now find commercial use in Europe. Diagram shows one arrangement, with opposed-piston diesel cylinder in center, air cylinder at ends. For details, see POWER, Feb 1951, pp 84-86.



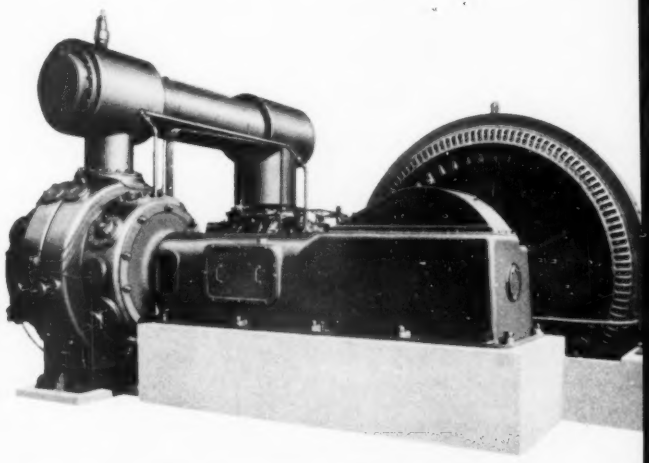
2 "Package-type" compressor has components on a single base for easy mounting directly on plant floor, is water-cooled



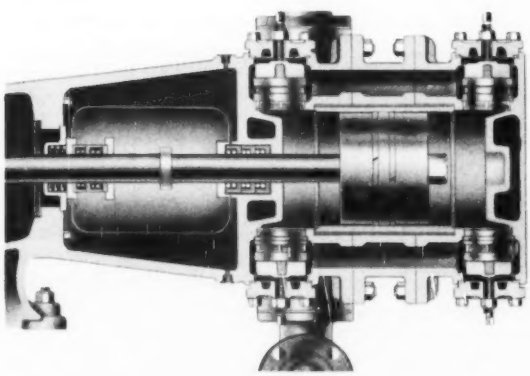
3 Another package-type compressor has its cylinders at right angles, takes little space. Water-cooled, 2-stage, 350-hp



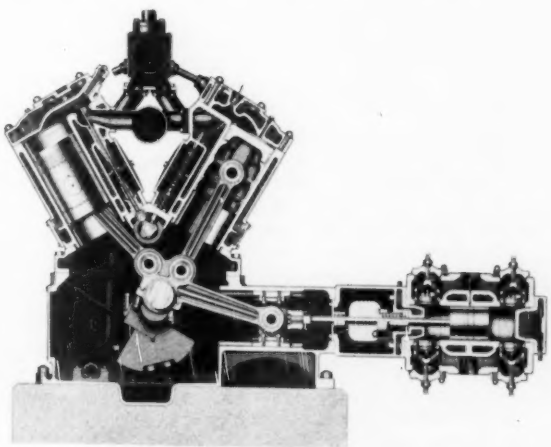
5 Horizontal single-frame units like this are built in wide range of capacities. Normal pressure rating is 100 psi



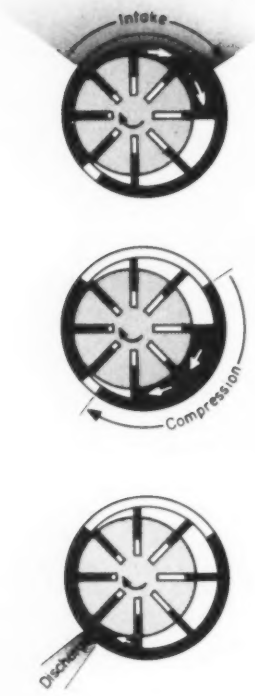
6 Duplex double-acting compressor is typical of designs in this type for 80 to 125 psi. Made in wide capacity range



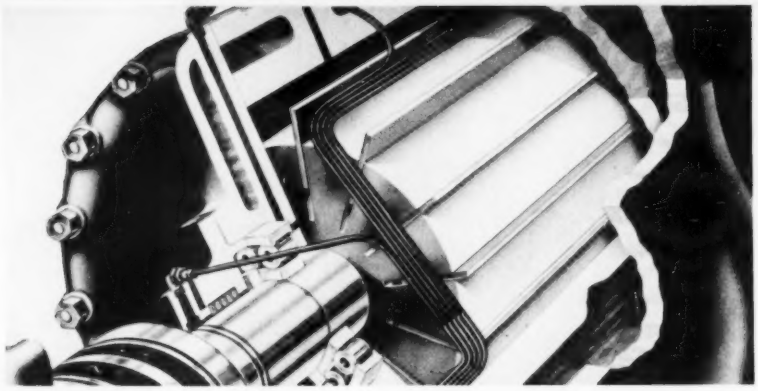
8 Oilless compressor uses no lubricant in cylinder, discharges oil-free air. Cylinder liner is carbon, backed with steel



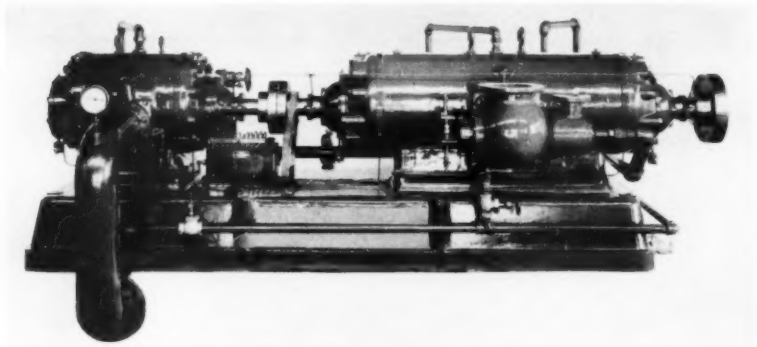
9 This V-type gas engine drives horizontal air compressor; two units are combined in a single frame for compactness



SLIDING-VANE design traps air between vanes, compresses by reducing volume



CUTAWAY VIEW of a sliding-vane rotary compressor showing water-jacketed cylinder, rotor with axis eccentric to that of cylinder, vanes that move radially in slots



TYPICAL SLIDING-VANE COMPRESSOR has three points in cylinder, one in each head, that get oil from force-feed lubricator driven from either motor or compressor shaft

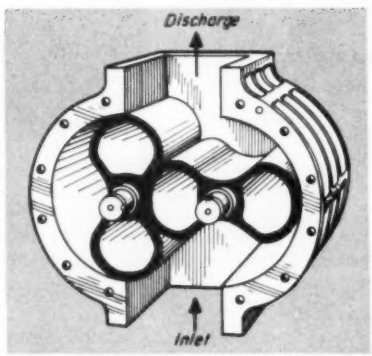
Rotaries

Rotary compressors, as we saw earlier, are positive-displacement units. Diagram, *above*, shows events in one revolution of a sliding-vane unit. Depending on design, cooling may be with atmospheric air, oil or water. For pressures to 50 psi, one stage is used, two stages for higher pressures. Capacities range to about 5000 cfm.

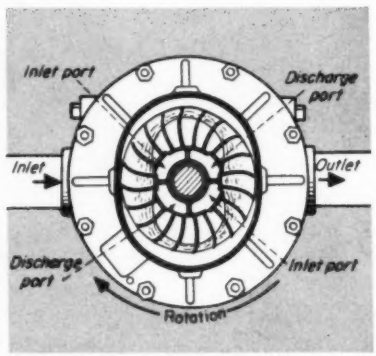
Some compressors of this type have rings around the vanes to keep them from bearing on cylinder walls. Others have vanes bearing against cylinder.

Lobe Types. Two- and three-element positive-displacement designs, *right*, have capacities from 5 to about 50,000 cfm. Pressures above about 15 psi are obtained by operating two or more units in series. Impellers are straight, as shown, or slightly twisted.

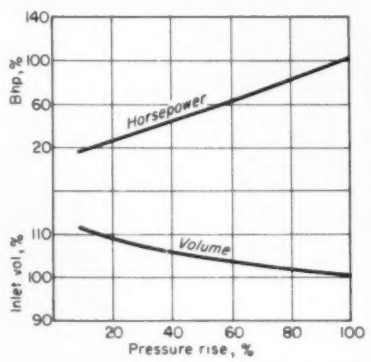
Liquid-piston compressors, *right*, handle up to about 5000 cfm. Single-stage units can develop pressures to 75 psi; multistage designs are used for higher pressures. Water or almost any other low-viscosity liquid serves as the compressant. For exacting services, compressor may be sealed with chilled water to prevent condensation in lines.



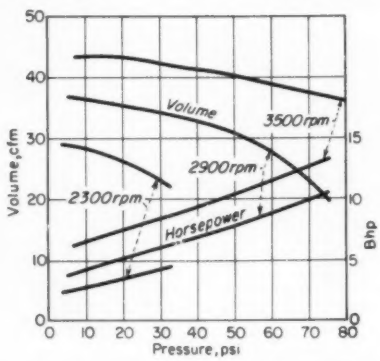
TWO-LOBED impellers rotate in opposite directions, carrying the air with them



LIQUID-PISTON unit has shrouded vanes rotating in casing, no metallic contact

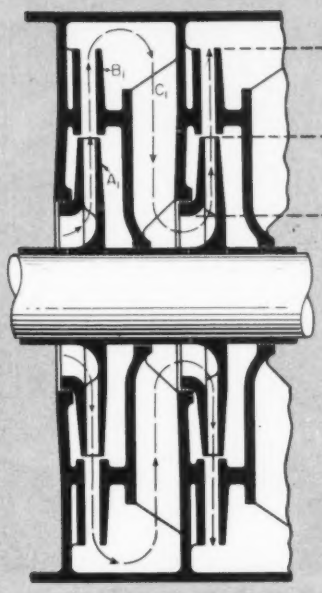


CHARACTERISTIC curves for a constant-speed two-impeller-type air compressor

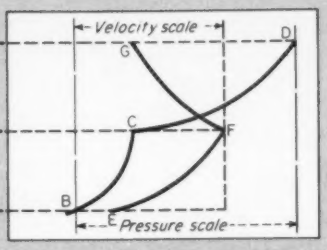


TYPICAL PERFORMANCE curves for single-stage liquid-piston unit show power, cfm

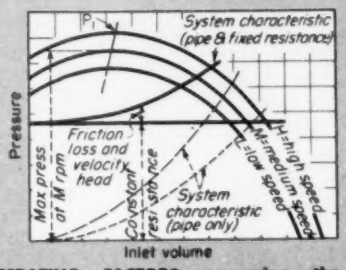
Centrifugal Compressors Can Supply Large Volumes of Air



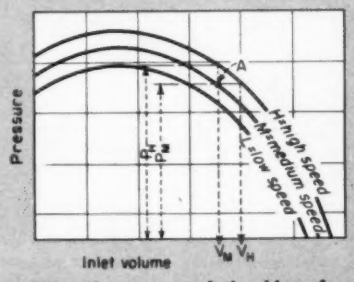
AIR FLOW through centrifugal compressor follows paths shown in this drawing



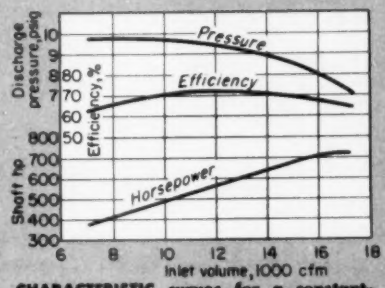
PRESSURE and velocity relationships of air in a typical centrifugal compressor



OPERATING FACTORS governing the action of a centrifugal at a fixed load



VOLUME and pressure relationships of a centrifugal compressor at various speeds



CHARACTERISTIC curves for a constant-speed machine driven by electric motor

Centrifugals

In centrifugal compressors, air travels essentially radially. Look at the section above and the related diagram in which pressure and velocity are plotted against radial travel.

How Centrifugals Work. Centrifugal action of impeller produces some pressure rise (*BC*) and a big increase in air velocity (*EF*). In the diffuser (B_1 in section), velocity energy is converted to static pressure. Velocity falls from *F* to *G*, pressure rises from *C* to *D*.

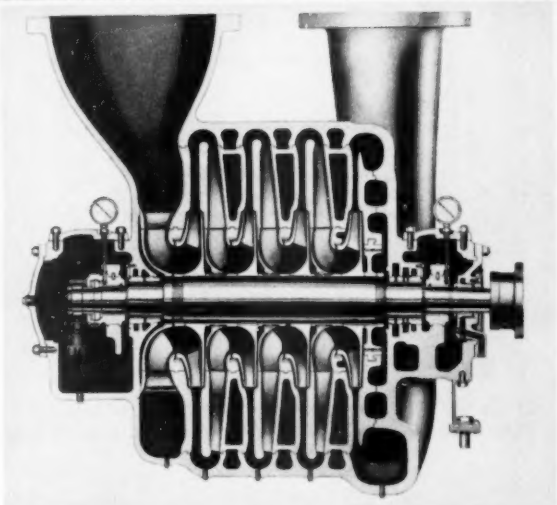
Pressure-volume curves for centrifugal compressors resemble those shown, *above center*. Each curve is for a different compressor speed. Unit running at speed *M* delivers volume V_M at pressure P_M (point *A*). Increasing speed to *H* raises volume to V_H at P_M or old volume V_M can be delivered at higher pressure P_H.

Curves, *top right*, show how compressor runs when discharging through a pipe to a system with constant resistance, and through pipes only. If discharge pressure falls below P_1, operation may be unstable.

Pressure delivered by a centrifugal is practically constant over a relatively wide range of capacities. As a close approximation you can consider shaft hp to vary as the cube of compressor operating speed if characteristics of system into which unit discharges are held constant.

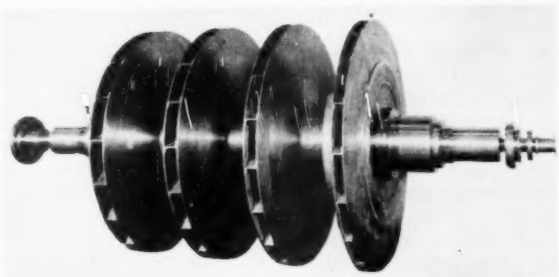
Pumping limit, also called surge point or pulsation point, is lower limit of stable operation. Percentage stability is 100 minus the pumping limit in percent of design capacity.

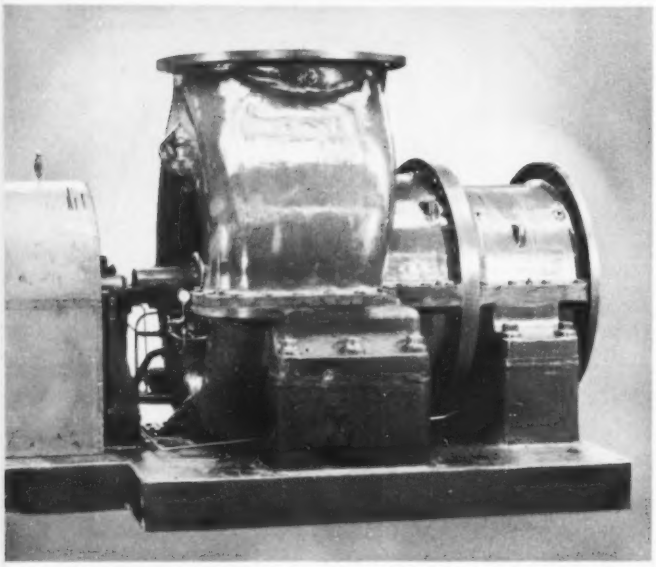
Multistage centrifugal compressors handle 500 to more than 150,000 cfm, at pressures to 150 psi. For pressures under about 35 psi, centrifugal units are usually classified as blowers. Except in smaller sizes there is little mechanical difference between blowers and compressors.



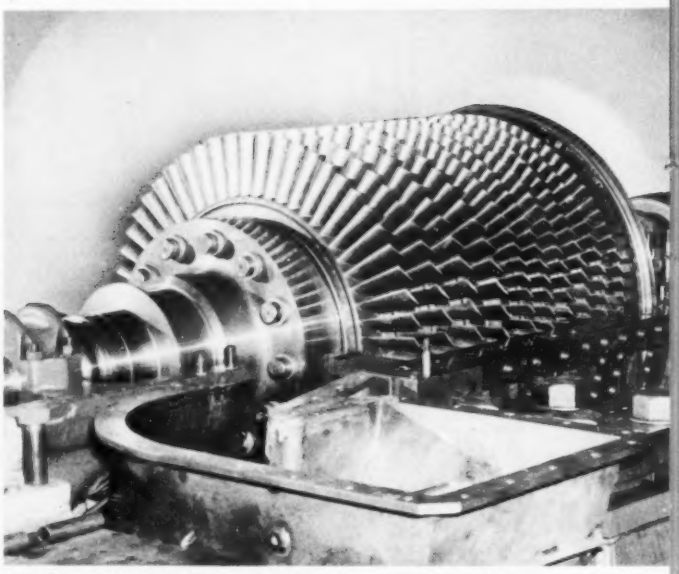
LONGITUDINAL SECTION of 4-stage centrifugal suitable for supplying large quantities of air. Discharge pressure to 150 psi

ROTOR for typical multistage centrifugal compressor. Impellers are of enclosed (fully shrouded) single-suction design

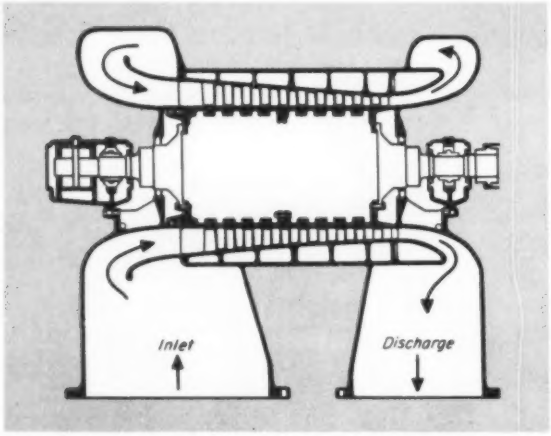




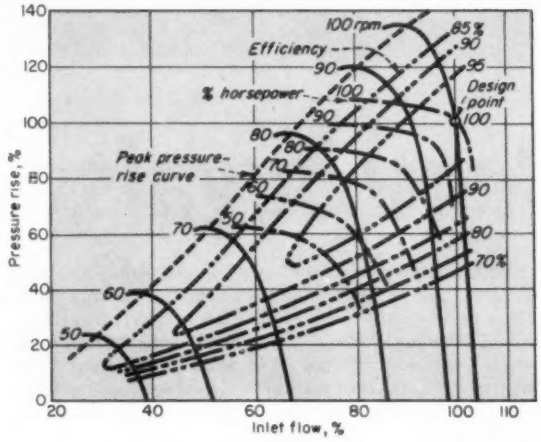
TURBINE-DRIVEN large-volume low-pressure axial compressor. Four-stage, it handles 50,000 cfm. Note axial inlet at right



ASSEMBLY of an 11,000-hp axial-flow air compressor designed to handle large volumes of air. Note construction of the rotor



CROSS SECTION of an axial-flow compressor suitable for handling large quantities of air. Note straight-through flow path



PRESSURE-VOLUME characteristic of axials is steep, making them well suited to fixed-volume large-pressure-change jobs

Axial-Flow

In axial-flow compressors, air moves generally parallel to the shaft axis, *diagram above*. Single-stage axial blowers have capacities from a few cfm to more than 100,000, at pressures from less than one to several psi. Multistage axials compress air to 150 psi or more. Some special machines handle over one million cfm. Pressure rise per stage is generally relatively small so units for higher pressures frequently have a considerable number of stages.

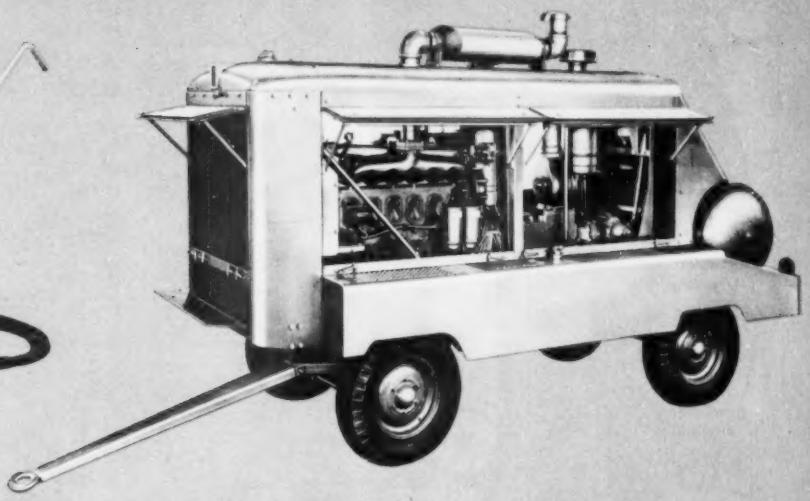
While centrifugal machines deliver practically constant pressure over a considerable range of capacities, axials have a substantially constant delivery at variable pressures. In general, centrifugals have a wider stable operating range than axials.

Because of their more or less straight-through flow, axials tend to be smaller in diameter than centrifugals, and are apt to be longer. Efficiency of axials usually runs slightly higher.

To prevent surging at extremely low loads, large-capacity axials are sometimes fitted with a blowoff system that discharges excess air to the atmosphere. With this hookup there is always enough air passing through the machine to keep it in stable range.

Because of difficulty in accurately predicting the characteristic curves of centrifugal and axial compressors, only one capacity and one discharge-pressure rating, together with corresponding power input, are normally guaranteed. Shape of the characteristic curve may be indicated but is never guaranteed.

MOTOR-DRIVEN portable design for plant maintenance work supplies 150-psi air



PORTABLE COMPRESSOR rated 600 cfm is a 2-stage diesel-driven sliding-vane rotary. Light, compact, it is easily towed

Portables

Portable compressors find ever wider use in industrial plants for maintenance, spray painting, filter cleaning, tire inflating, and many other tasks. Smaller units are easily moved about by one or two men for spot jobs of all kinds. Having portables on hand prevents overloading the main air system when a lot of maintenance work must be done or other peaks occur. And, of course, portables are still the old standby in all types of industrial construction.

Completely self-contained, portables may be skid-, truck- or tractor-mounted, or may have two or four wheels, with or without springs and tires.

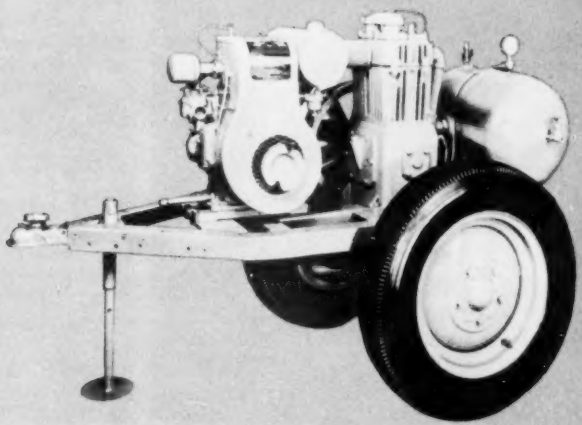
Standard portables are rated for 100-psi discharge pressure at sea level. Sizes are stated in model numbers, corresponding to compressor capacity in cfm of free air delivered at 100 psi at sea level. *Model 60*, for instance, is rated at 60 cfm, *Model 105* at 105 cfm, *Model 600* at 600 cfm. Maximum standard capacity is 600 cfm.

Most portables available today are reciprocating units, driven by either gasoline or diesel engines. One type, however, uses a 2-stage sliding-vane rotary compressor. Portables designed specifically for in-plant use may be driven by gasoline, diesel engines or electric motors, whichever works out best for a given plant.

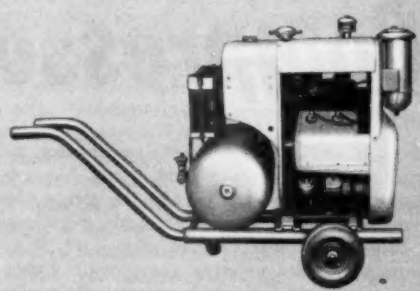
Self-propelled compressors, of the tractor type, may prove more useful than straight portables in large industrial plants. Many different auxiliary parts can be fitted to them. These include a snow plow, front-end loader, rotary brush, rear winch, booms of different lengths, post-hole digger, lawn mower, portable scaffold, earth auger, back hoe, and other useful devices.

Similar units are also available in crawler designs with steel tracks for towing, climbing or pushing, besides supplying compressed air. Standard model numbers for portables apply to self-propelled units, too.

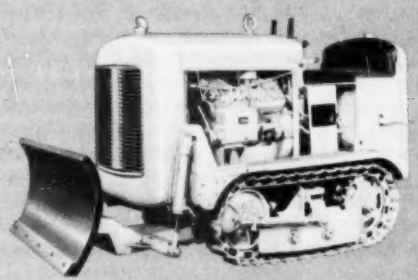
All present-day designs of portables and self-propelled units include compressor, prime mover, and air receiver, complete with cooling, lube, regulating and starting systems.



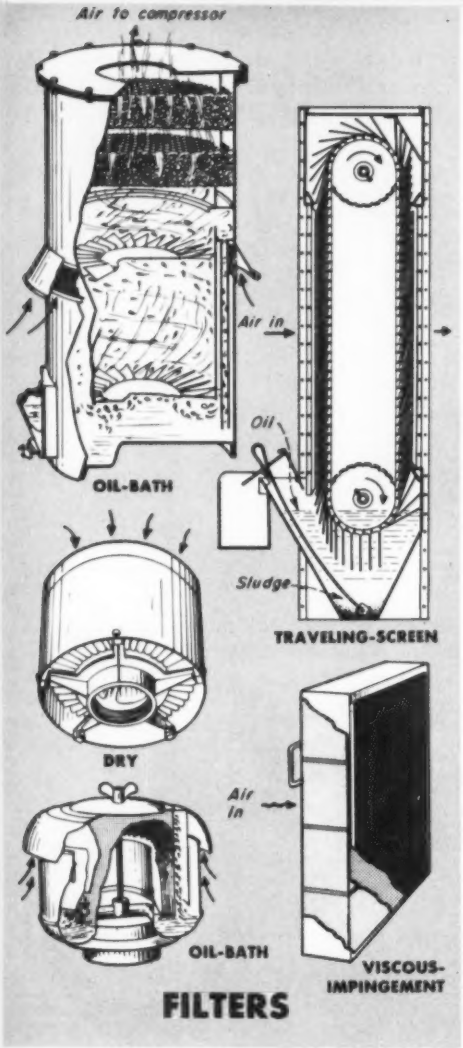
TRAILER-MOUNTED portable, single-stage air-cooled for 70-80 psi. Drive is gasoline engine (or motor)



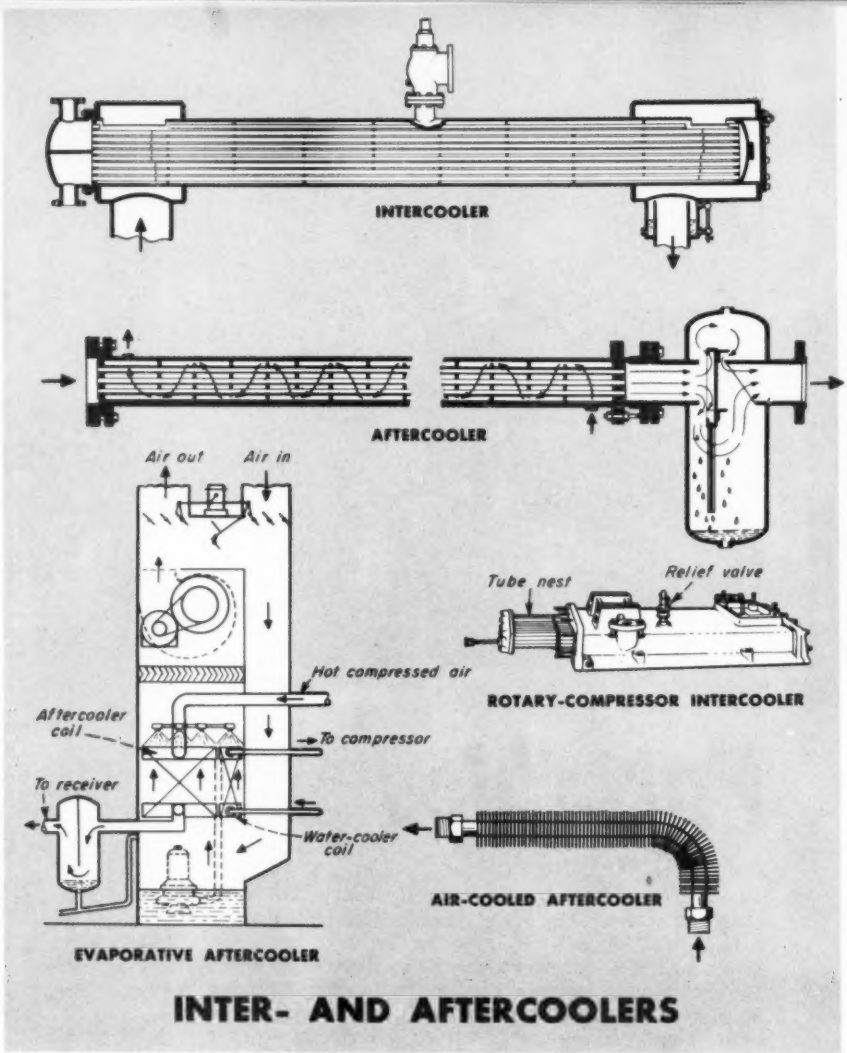
LOW-SLUNG shop truck has two pneumatic-tired wheels and a caster wheel, is easily hauled around



CRAWLER-TYPE self-propelled compressor can be fitted with many tools, is useful in large industrial plants



FILTERS



INTER- AND AFTERCOOLERS

Compressor Accessories

Heart of any air system is the compressor, but a number of auxiliary devices are needed. Some, like inter- and aftercoolers, may come as part of the compressor; others, like separators, are accessories, usually come separately.

Intake-air filters prevent dust and other atmospheric impurities from entering compressor. Dust, for example, may cause sticking valves, scored cylinders, excessive wear.

Sketches, *above left,* show several typical filter designs. *Viscous-impingement* types—rectangular or cylindrical—are packed with fine strands of wire coated with oil. Air passing through impinges on wires, oil film traps dust. *Oil-bath filters* have a reservoir of oil agitated by incoming air. Oil-coated dust collects in oil reservoir.

In *traveling-screen filters,* air flows through a screen continuously coated with oil by passage through a reservoir. Dust caught on screen is washed off in oil bath.

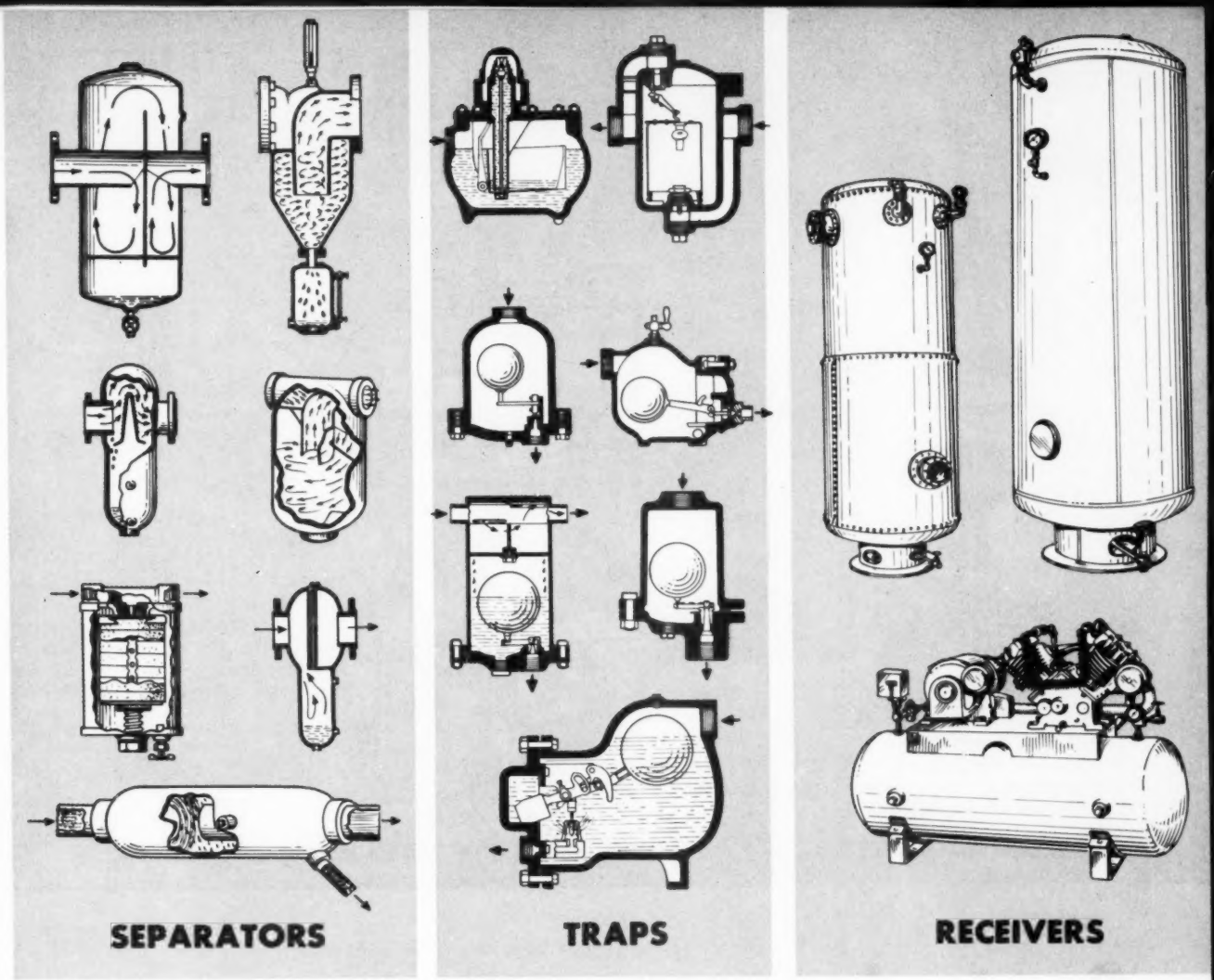
Dry-type filters have felt or other filtering media held in rectangular or cylindrical frames. Some types of filtering materials may be vacuum cleaned, others are designed to be used just once, in *throwaway* elements.

Inter- and Aftercoolers. Atmospheric air, as we saw earlier (p 86), contains moisture. And in passing through compressor, air may pick up atomized oil. So discharge air usually carries water and oil vapor, and is at an elevated temperature as a result of the compression process.

Water that reaches air tools may wash away lubricant, causing excessive wear. It may also reduce pipe capacity by collecting at low points, where it may freeze in cold weather. Water hammer may also be a problem.

Oil in air can damage rubber gaskets and air hoses, plug discharge piping if it carbonizes. It's objectionable in some jobs—paint spraying, cleaning of electrical equipment, agitation of liquids.

One way of removing water and oil vapor is to cool air. When done between stages in a multistage compressor, an *intercooler* is used. It may be either a water-cooled shell-and-tube unit for large compressors or a finned-tube air-cooled type for small units. Water and oil are often collected in a trap at cooler's discharge end. Gage glass shows water level and a drain connection is provided. Besides removing



unwanted vapors, intercooling also reduces power input to compressor—see p 86 for details.

Aftercoolers reduce temperature and moisture content of air leaving the compressor's last stage. These may be water- or air-cooled, like intercoolers. Evaporative aftercoolers cool both air and compressor cooling water.

Sketches, *above*, show several typical designs of aftercoolers. Many water-cooled units incorporate a separator. Temperature of air leaving cooler is usually within 2 to 15 F of cooling water. In some plants today, chilled water is used for maximum vapor removal. For drying air to be used in pneumatic instruments, silica gel, alumina or other adsorbents may be used. These are reactivated by heating after they become saturated.

Separators. Because aftercoolers remove moisture and oil only in proportion to their ability to lower air temperature, separators are generally used between aftercooler and receiver. They are also used in branch lines where there is danger of condensation, or where tools or devices served need protection of an additional separator.

Sketches, *above*, show only a few of the many separator designs in use today. Some utilize centrifugal force or a sudden change in flow direction to throw out moisture particles. Others employ rotating impellers, felt disks, porous stone cups or disks to separate moisture. One design has a water-cooled condenser in the separator body.

Traps, *above center*, are often used at separators, drain pockets and in tool lines to discharge condensed moisture. Since much air may be lost through traps discharging continuously, and since condensation in air lines is not as rapid as in steam lines, intermittent-discharge traps are usually recommended for air service.

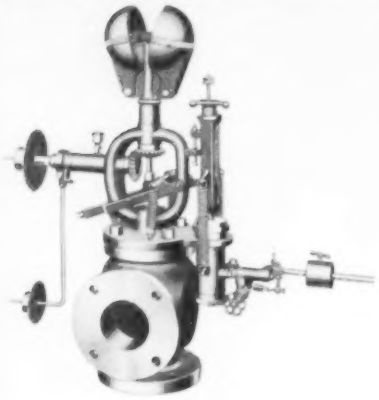
Air traps closely resemble those for steam service, inverted-bucket, upright-bucket and float types being among those used. Traps discharge oil as well as condensed water. Of many designs a few are illustrated above.

Receivers dampen pulsations or pressure waves in compressor discharge, act as reservoirs and precipitate any moisture that may be carried over from aftercooler.

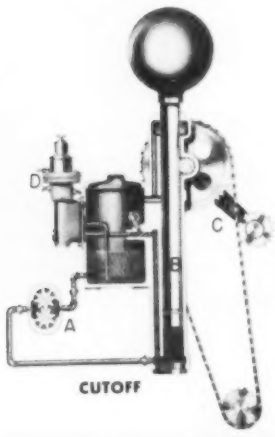
Large receivers are usually vertical, *above right*. Small ones may be horizontal or vertical, depending on space available. Many states require that air receivers conform with ASME code for unfired pressure vessels. Receivers built in accordance with code are standard size, fitted with openings for inspection and cleaning, plugged opening for a regulator, and with safety valve, pressure gage and drain valve. Construction may be either welded or riveted. Metal mounting base is usually furnished with receiver.

Silencers are available for installations where compressor inlet or discharge noise is objectionable.

Protective devices for compressors take a variety of forms. Typical ones are listed and discussed on p 103.

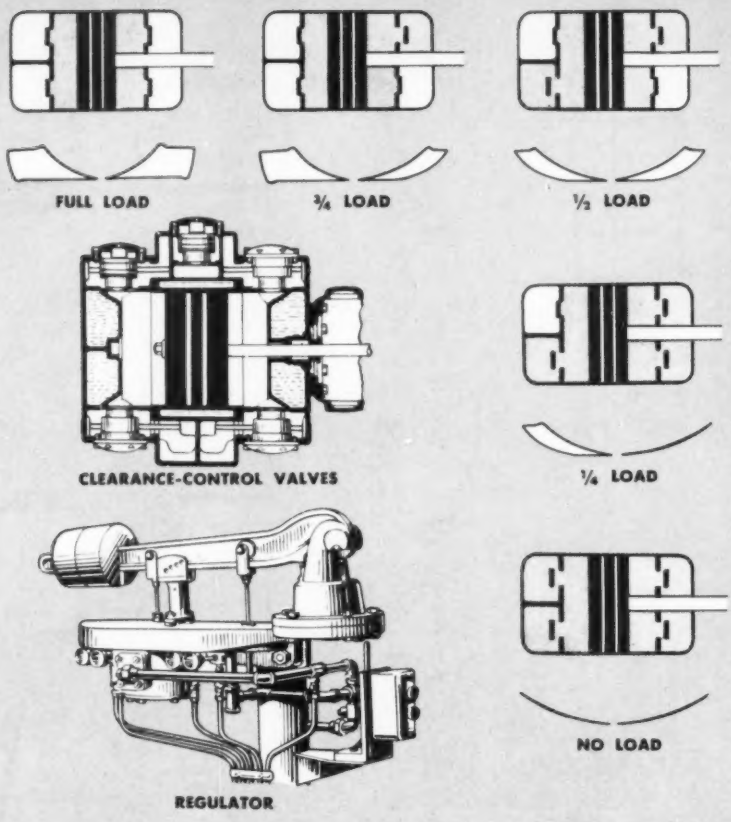


THROTTLING



CUTOFF

STEAM-ENGINE GOVERNORS



CONTROLS FOR MOTOR-DRIVEN UNITS REDUCE CAPACITY . . .

Control

Compressor controls permit you to regulate output to load. For reciprocating units, type depends on drive, nature of load and other factors.

Steam-driven compressors usually have combination speed and pressure governors that vary air capacity by changing speed. They are available in two types: (1) *Throttling* governors vary steam pressure, reducing it as air-discharge pressure rises. (2) *Automatic-cutoff* governors change cutoff point of valves in steam cylinder.

Throttling design, *top left*, is used with manually adjustable cutoff in plants having steady supply of exhaust steam or where conditions are so nearly constant an automatic-cutoff governor would have little chance to function. Cutoff is set manually at desired point, governor holds constant air pressure by varying machine speed.

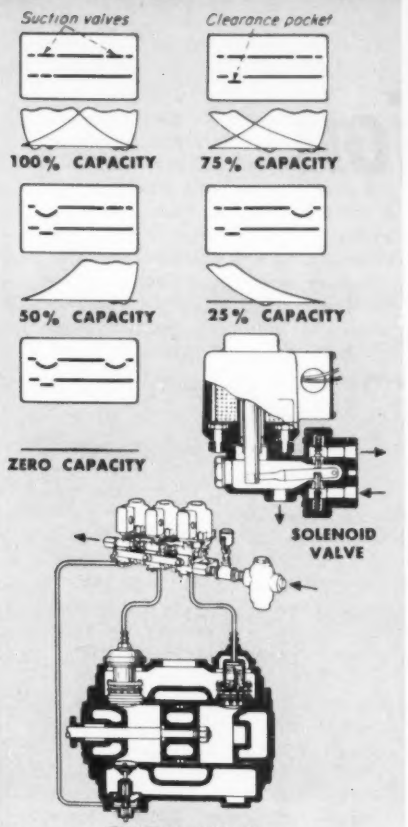
One design of automatic-cutoff governor, *above left*, has a gear-type oil pump, *A*, chain-driven from main shaft. Oil under pressure from pump acts on piston *B*. Any steam-pressure change tending to shift compressor speed is instantly reflected in an increase or decrease of oil pressure. This causes piston movement, which rotates sprocket combination *C* to reset cutoff and restore required speed. Variations in air demand acting through diaphragm valve *D* (connected to receiver) also affect oil pressure by permitting some oil to bypass. In these two ways, speed is controlled according to load demand and steam conditions.

Motor-driven and other types of constant-speed compressors usually have one of three types of controls: (1) Constant-speed control decreases compressor capacity automatically in one or more steps by means of an unloader. (2) Automatic start-and-stop control uses a starter and pressure switch. This control works well where air demand is intermittent with long periods of no demand and where precise pressure regulation is unnecessary. (3) Dual control is a combination of (1) and (2). It allows continuous operation when demand is nearly continuous, and automatic start-and-stop when demand is low.

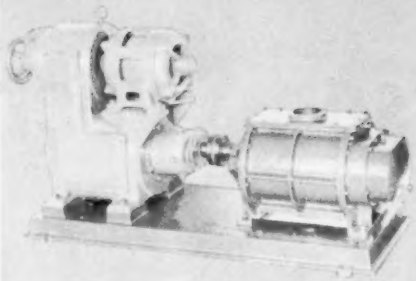
Step Control. Two designs of constant-speed 5-step control are shown above. Each unloads compressor in five steps, reducing capacity from full load to ¾, ½, ¼ and no load as demand decreases. Five-step control is almost universal on compressors of 150 hp or more. Many smaller compressors have 3-step controls. Most single-acting units (15 to 125 hp) have 1-step control for unloading.

With one type of 5-step control, above, each end of each cylinder has two clearance pockets fitted with an air-operated clearance valve opening into the cylinder bore. When one valve is open, pocket volume is added to normal clearance volume. This reduces intake-air quantity to half that normally taken in by that end of cylinder. Pocket size is proportioned so when both pockets at one end are open, no air is taken into that end of cylinder when operating at rated pressure.

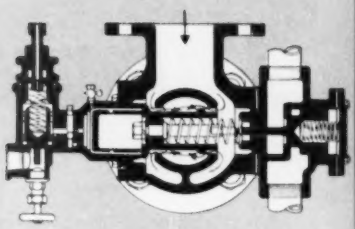
Regulator for 5-step control has a diaphragm connected to receiver pres-



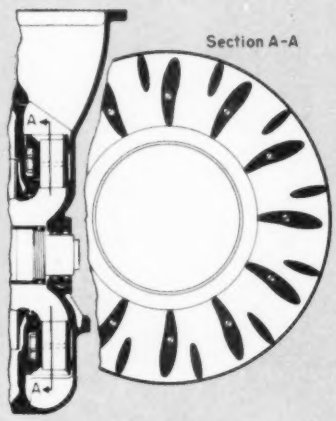
... IN FIVE STEPS OR LESS



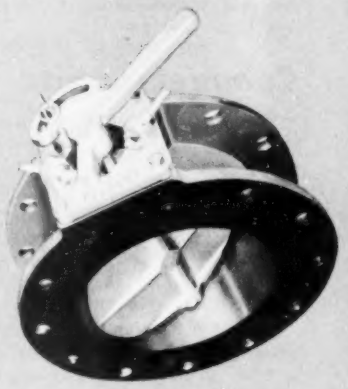
VARIABLE-SPEED DRIVE



INTAKE UNLOADER FOR SLIDING-VANE COMPRESSOR



ADJUSTABLE INLET-GUIDE VANES



HAND-OPERATED BUTTERFLY VALVE

SOME CONTROLS FOR ROTATING COMPRESSORS

sure to operate a pilot valve. This causes auxiliary valves to open and close to admit and exhaust pressure from clearance-control valves.

Suction valves as well as clearance pockets are used in the 5-step control, *directly above*. Hookup is for a 2-stage 2-cylinder unit having one clearance pocket in each cylinder and an arrangement for unloading low- and high-pressure cylinders simultaneously.

Three solenoid valves control admission of air pressure to unloading elements. De-energizing the solenoids admits pressure for unloading. Energizing solenoids removes pressure from unloader, allowing compressor to load and discharge air. Automatic initial unloading, or unloading during abnormal electrical conditions, is obtained by interlocking the solenoid-valve circuit with the motor starter.

Energizing or de-energizing of solenoids in proper sequence (diagram) is under governor control.

Similar 5-step control for 2-cylinder single-stage compressors without clearance pockets unloads each end of each cylinder in sequence.

Automatic start-and-stop controls have a simple pressure-actuated switch connected to the receiver. Range between starting and stopping pressures is usually about 20% of cutout pressure. Pressure-release valve automatically bleeds or unloads compressor, permitting it to start against no load.

Dual-control schemes have a manually operated switch for changing from automatic start-and-stop to constant-speed control. They prove most economical in plants with heavy and light demand periods.

Rotary compressors may be controlled by varying speed, by unloading, or by the dual method. Illustrated above is an automatic intake unloader for a sliding-vane unit.

Pressure developed in some types of rotaries depends on system resistance. Since most units are designed for a specified maximum pressure differential, a relief valve is needed on discharge to protect against an excessive discharge pressure.

Centrifugal compressors are controlled by three methods: (1) variable speed (2) movable internal vanes (3) suction or discharge throttling.

Variable-speed control is efficient and widely used. It is obtained directly with turbines, wound-rotor or dc motors. Hydraulic or magnetic couplings, or some other variable-speed drive, are needed with squirrel-cage induction or synchronous motors.

Inlet-guide vanes, at first impeller or at each impeller, can be used to modify the performance characteristics of centrifugals. Such vanes may be made manually adjustable or, in some cases, automatically adjustable.

Suction or discharge throttling is the least efficient control method. Butterfly valve in inlet line artificially reduces inlet pressure to change output. Or butterfly in discharge reduces compressor outlet pressure. Inlet throttling is more efficient, finds greater use.

Axial-flow-compressor control depends on application. One type, for example, regulates driving-turbine speed to maintain constant air flow. Discharge side of system has separately controlled blowoff valve for unusual operating conditions that take compressor out of its stable range.

Compressor Selection

Up to this point, the compressors and accessories we've covered have not been classified for ultimate use. But since most power engineers handle so called "shop" air systems, we'll concentrate on these familiar plant hookups from here on.

Compressor Size

Compressor selection takes experience and judgment, but there are some guides that often prove helpful. To show how you can use them, we'll set up a typical compressor-selection problem and solve it. But remember, every time you pick a compressor you should have the maker check your figures from start to finish.

First step in compressor selection is determination of air quantity needed and top pressure to operate any air device in the plant. Table I gives consumption of a number of typical air tools. You can use these figures for a first estimate, or obtain exact values from tool manufacturers.

Most air tools are designed for operation at 90 psi. Unless maker specifically states otherwise, tool performance figures and capacity ratings are based on an air supply providing 90 psi *at the tool* when it's being used.

Assume our plant is a new one and will use tools listed above. Beside each tool put its average air consumption in cfm (column *a*). Obtain this from tool manufacturer or Table I. Tabulate in column *b* the number of tools of each type. Then multiply columns *a* and *b* to find total air consumption of each type of tool, column *c*.

Load Factor. Few air tools operate continuously. As a result, their *net* air consumption is usually less than the *average* value stated by the maker or listed in Table I. Ratio of actual air consumption to that for full-load continuous operation is called *load factor*.

Two items are involved in load factor. First is the *time factor*, or percent of total time the tool or device actually uses air. Second is *work factor*, or percent of maximum possible work output actually done by the tool. For example, air consumption of a grinder with wide-open throttle depends on how hard operator pushes it against the work. Load factor is thus the product of time and work factors.

As you see, load factor is extremely important in compressor selection. For a given tool, load factor can normally vary from 0 to 100%, depending on tool type, its use, production rate, operator's habits, etc.

Best way to determine load factors for a new plant is by consulting the tool makers. In a plant that's been operating for some time you can use past experience as a guide, plus data from tool manufacturers. Just be certain that load factors you choose represent usual procedure in your plant. Enter factors in column *d*, as shown. Note: Tabulated values apply only to this example and should not be taken as representative. Each plant is different and load factors vary considerably.

Multiply value in column *c* by that in *d* for each tool. Result, column *e*, is average air demand of each group of tools. Add the results in *e* to get total average demand of all tools in plant. This sum is a rough indication of compressor capacity needed if it includes only tools normally used and omits those stored in toolrooms or out of service for other reasons.

Leakage. Some plant designers add an arbitrary item of 10% for piping and tool leakage. This practice isn't approved by the Compressed Air and Gas Institute. They recommend tight piping and good tool maintenance instead.

Remember, compressed-air usage tends to increase in most plants. If you expect system load to increase soon, insert a factor so the compressor you buy can handle new loads. It is usually more economical to provide additional capacity at start than later.

Typical Computation of Compressed-Air Requirements

Tool	(a) Air consumption, cfm	(b) Number of tools	(c) Air req'd, cfm (a x b)	(d) Load factor	(e) Probable air demand, cfm (c x d)
Grinding wheel, 6 in.	50	5	250	0.3	75
Rotary sander, 9-in. pad	55	2	110	0.5	55
Chipping hammers, 13 lb	30	8	240	0.4	96
Nut setters, 5/16 in.	20	10	200	0.6	120
Paint spray	10	1	10	0.1	1
Plug drills	40	3	120	0.2	24
Riveters, 18 lb	35	5	175	0.4	70
Steel drill, 7/8 in., 25 lb	80	5	400	0.4	160
					601*

*To this value must be added allowance for future needs and expected leakage loss, if any.

Special Needs

Where compressors supply air for services other than tools, you must consider some other angles. For instance, air for pneumatic instruments must be absolutely clean and oil-free. Also, it may be needed at a lower pressure than for tools—often in the 20-psi range. So we find liquid-piston, lobe, sliding vane and oilless compressors, popular for this service.

Compressors for soot blowing come at the higher end of the pressure scale, with a discharge pressure of 500 psi common in some plants. By storing air in receivers at 500 psi and reducing to 250 psi before use, a smaller compressor can be installed.

Some of the compressors discussed earlier find use in industrial vacuum service with little or no change. Under these conditions, intake pressure is below atmospheric, discharge is atmospheric or slightly above.

Your best bet on all applications, specialized or not, is to work closely with the compressor maker. His long experience assures you that the unit he recommends will give good service.

Drive. Motors, gas, gasoline, diesel, steam engines, or turbines are used to drive air compressors. Choice of drive is a matter of economics, involving

fuel cost, availability, cost of electricity, chance of electrical outages, availability of steam and a number of other factors. Plants needing more than one compressor may benefit by using a motor on one, prime movers on others.

Figures in Tables II-V help in making an economic analysis. Note the bases on which they're calculated and adjust if your conditions differ. Be sure to have compressor manufacturer check your choice of drive to see if it is entirely suitable for your plant.

Compressor Type

Compressed Air and Gas Institute gives the following relations between pressure and number of stages: 0-150 psig, single stage; 80-500 psig, two; 500-2500 psig, three; 2500-5000 psig, four stages. These ranges are for usual positive-displacement units.

Before choosing a specific type of compressor you must consider a number of factors including: discharge pressure required, capacity needed, power-supply characteristics, availability and cost of cooling water, space needed for compressor, type of control desired, compressor weight, type and size of foundation, and amount of maintenance expected.

Use the general ranges above to give a rough indication of number of stages for positive-displacement units. Send a complete picture of your air requirements to several manufacturers for their recommendations on type and size of compressor that is best for your plant and its load.

Never overlook the help you can get from manufacturers when it comes to picking a compressor. They will gladly give you estimated operating costs for different service conditions, drives, cooling arrangements, etc. Remember, the average life of a compressor is usually 20 years or more. So every decision you make that affects the operating cost will be with you for a long time.

Details given earlier, pp 88-95, help you choose between the two basic types — positive displacement and dynamic. Once this decision is made you can make a further study of the characteristics of various compressor types to see which one will be best for your job. Just remember that the selection of a compressor is an engineering decision that should take every factor into consideration.

Efficiency. One good measure of compressor efficiency is bhp per cfm. While efficiency is always important, especially when load factor and power cost are high, air pressure at tools is just as important. We'll take a look at this on the next two pages.

I—Approximate Air Needs of Pneumatic Tools, Cfm

Grinders, 6- and 8-in. diameter wheels	50
2- and 2½-in. diameter wheels	14-20
File and burr machines	18
Rotary sanders, 9-in. diameter pads	35
Sand rammers and tampers:	
1x4-in. cylinder	25
1¼x5-in. cylinder	28
1½x6-in. cylinder	39
Chipping hammers, 10-13 lb	28-30
2-4 lb	12
Nut setters to 5/16 in., 8 lb	20
½ to ¾ in., 18 lb	30
Paint spray	2-20
Plug drills	40-50
Riveters, 3/32- to 1/8-in. rivets	12
larger, weighing 18-22 lb	35
Rivet busters	35-39
Steel drills, rotary motors:	
To 1/4 in., weighing 1¼-4 lb	18-20
¼ to ⅜ in., weighing 6-8 lb	20-40
½ to ¾ in., weighing 9-14 lb	70
⅞ to 1 in., weighing 25 lb	80
Wood borers to 1-in. diameter, weighing 14 lb	40

II—Cost of Gas to Compress and Deliver Free Air

(Cents per 100 cu ft, based on fuel consumption of 10,000 Btu per bhphr)

Bhp per 100 cfm free air	Price of gas in cents per 1000 cu ft of 1000-Btu gas							
	10	15	20	25	30	35	40	45
16	0.026	0.039	0.052	0.065	0.078	0.091	0.104	0.117
18	0.029	0.044	0.059	0.073	0.088	0.102	0.117	0.132
20	0.033	0.049	0.065	0.081	0.098	0.114	0.130	0.146
22	0.036	0.054	0.072	0.090	0.107	0.125	0.143	0.161
24	0.039	0.058	0.078	0.097	0.117	0.136	0.156	0.176
26	0.042	0.063	0.085	0.106	0.127	0.148	0.169	0.190
28	0.045	0.068	0.091	0.114	0.137	0.159	0.182	0.205
300	0.049	0.073	0.098	0.122	0.146	0.170	0.195	0.220

III—Cost of Fuel Oil to Compress and Deliver Free Air

(Cents per 100 cu ft based on fuel consumption of about 0.45 lb per bhphr)

Bhp per 100 cfm free air	Price of fuel oil (18,500 Btu per lb) in cents per gallon							
	3	4	5	6	7	8	9	10
16	0.050	0.067	0.083	0.100	0.117	0.133	0.150	0.167
18	0.056	0.075	0.094	0.113	0.131	0.150	0.169	0.189
20	0.063	0.083	0.104	0.125	0.146	0.167	0.188	0.210
22	0.069	0.092	0.115	0.138	0.160	0.183	0.206	0.230
24	0.075	0.100	0.125	0.150	0.175	0.200	0.225	0.251
26	0.081	0.109	0.136	0.163	0.190	0.217	0.244	0.272
28	0.088	0.117	0.146	0.175	0.204	0.233	0.262	0.293
30	0.094	0.125	0.156	0.188	0.219	0.250	0.281	0.314

IV—Cost of Gasoline to Compress and Deliver Free Air

(Cents per 100 cu ft, based on fuel consumption of about 0.75 lb per bhphr)

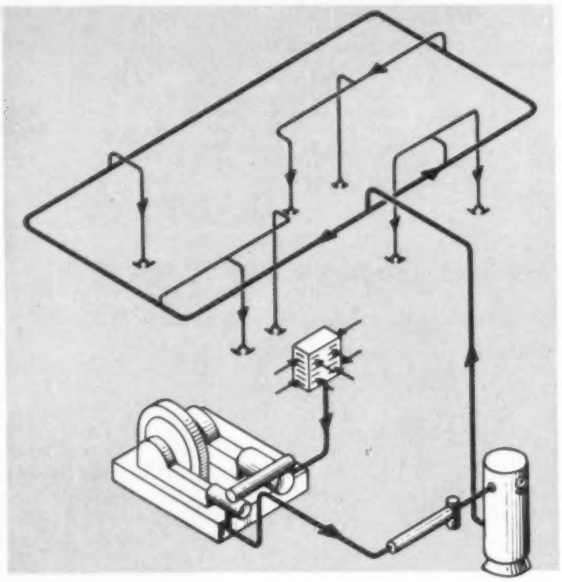
Bhp per 100 cfm free air	Price of gasoline, cents per gallon							
	8	9	10	11	12	13	14	15
16	0.267	0.300	0.333	0.367	0.400	0.433	0.467	0.500
18	0.300	0.338	0.375	0.413	0.450	0.488	0.525	0.563
20	0.333	0.375	0.416	0.458	0.500	0.542	0.584	0.626
22	0.367	0.413	0.458	0.504	0.550	0.596	0.642	0.688
24	0.400	0.450	0.500	0.550	0.600	0.650	0.700	0.750
26	0.433	0.488	0.542	0.596	0.650	0.705	0.759	0.813
28	0.467	0.525	0.584	0.642	0.700	0.759	0.816	0.875
30	0.500	0.563	0.626	0.688	0.750	0.813	0.875	0.938

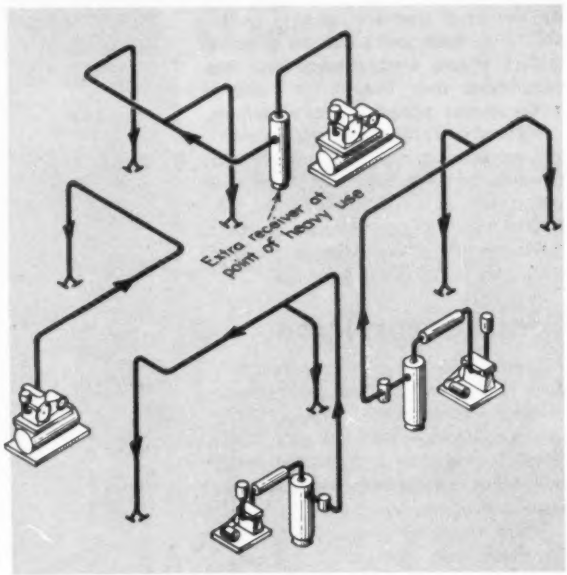
V—Cost of Coal to Compress and Deliver Free Air

(Cents per 100 cu ft, based on coal at $1.00 per ton and an evaporation rate of 7 lb water per lb coal. Multiply figures in table by actual coal price in dollars per ton)

Ihp per 100 cfm free air	Steam rate of engine in lb per indicated hphr							
	26	28	30	32	34	36	38	40
16	0.050	0.053	0.057	0.061	0.063	0.068	0.072	0.076
18	0.056	0.060	0.064	0.069	0.071	0.077	0.081	0.086
20	0.062	0.067	0.071	0.076	0.079	0.086	0.090	0.095
22	0.068	0.073	0.079	0.084	0.087	0.094	0.100	0.105
24	0.074	0.080	0.086	0.091	0.095	0.103	0.109	0.114
26	0.081	0.087	0.093	0.099	0.103	0.111	0.118	0.124
28	0.087	0.093	0.100	0.107	0.111	0.120	0.127	0.133
30	0.093	0.100	0.107	0.114	0.119	0.129	0.136	0.143

Study plant air needs before choosing distribution system...





System Layout

First step: Study your plant to see if it would be better served by one large compressor in a central location, or by several smaller ones in areas needing air. This important decision affects system costs from start to finish.

Central system, *above left,* has one or more large compressors in a more or less central location. Supply piping, often in the form of a loop, runs to areas needing air.

Advantages claimed for central systems include: low investment cost per unit of capacity, low unit power cost, chance to use synchronous motors to correct power factor, good pressure regulation, minimum wiring for motor drive.

Unit system, *above right,* has compressors spotted in areas using air. In the usual plant, each compressor serves the area in which it is located, with only emergency connections between the different areas.

Advantages cited for unit systems include: low initial investment, less pressure loss in piping, reduced engineering and planning, simpler installation, greater flexibility, easier financing of plant expansion, simplified purchasing. All these are fully discussed in POWER, Jan 1953, pp 75-77.

Study Needed. There are no simple rules to use in choosing a system. Each plant must be analyzed separately and the decision based on the results. For many years central systems have been popular in large industrial plants, and have given excellent service. Unit systems, while used in both large and small plants, are newer and are not yet as extensively applied in large plants.

Compressed-Air Piping

Regardless of compressor or distribution system chosen, piping is of major importance in every setup. Because piping conveys air from high-pressure source (compressor) to point of use (tool), it can be a definite help or hindrance in plant operation.

Good piping design limits pressure drop between compressor and tool because low pressure at the tool cuts production. We haven't space for a complete rundown on all angles of piping design but here are some helpful pointers:

Intake, Discharge. Have intake pipe at least as large as compressor intake opening. For every 10 ft of run from compressor, make line diameter one inch greater. Keep air velocity in intake below 2500 fpm. This cuts friction loss.

Make discharge line at least as large as compressor outlet opening; use as few bends as possible. Be sure run is short and direct. Fit valved drain to lowest point of discharge line and in any pockets formed by piping.

Support intake and discharge piping so vibration and strain don't reach compressor cylinder, aftercooler or receiver. Use gate-type shutoff valves in air lines to keep friction loss low.

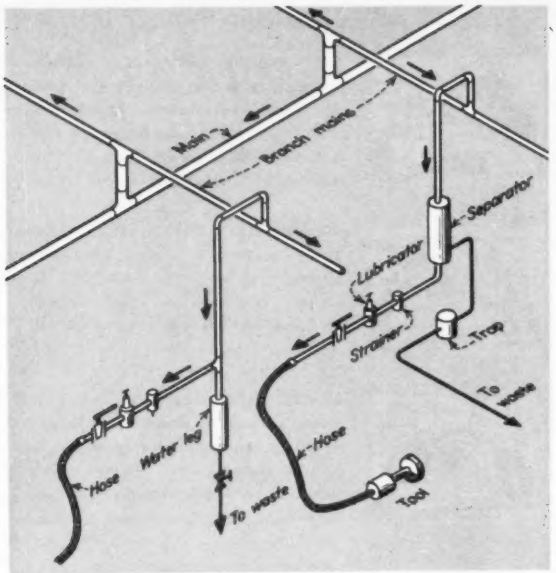
Distribution Piping. Line from receiver to point of use is generally sized so pressure loss is reasonable – below 5 psi. Provide outlets on each header or main for connection of hoses to air-operated tools or devices. Fit outlet to top of pipe so moisture won't drain from main into hose. If several tools connect to one outlet, be sure it is big enough to prevent excessive pressure loss. Sketch, *above,* shows a typical main with connections for several tools.

Always remember: *Low air pressure at tools can cause a far greater loss in plant income than a few points in compressor efficiency.* Next to low pressure, moisture and solids are the worst enemies of good air-tool operation. Make full use of separators, strainers, traps, drop legs.

Intake location is of prime importance because high temperatures reduce compressor output, as Table I shows. See that intake is as far as possible from heat, dirt and moisture sources and not too close to building walls and windows. Put intake on north side of building, if possible.

Receivers that are sized liberally reduce compressor loaded periods and insure more thorough cooling of air before it reaches tools. Use ASME standard receivers and fittings

...then pipe air tools properly



except where local codes differ. It is a good plan to install extra receivers near points of heavy usage to insure adequate volume and pressure, and smooth out flow in supply mains and branches.

Safety devices are needed to protect personnel and equipment from excessive pressure and other conditions that lead to trouble. Table III lists typical devices used in large plants; many would not be justified in small installations. Even the simplest system, however, is always fitted with a pressure-relief device of some sort on the discharge side.

Compressor Cooling

Good cooling is essential to good operation. Though air-cooled compressors may run satisfactorily in warm areas, make every effort to put them in cool spots. Capacity will be greater and there'll be fewer operating problems.

Suitable strainers in main water-supply line to water-cooled compressors protect against solids. Run piping so it won't interfere with maintenance work on cylinders and drive. Put drain valves at all low points so entire system may be drained during shutdown in freezing weather.

Fit each cylinder and intercooler with its own regulating valve, even though an automatic valve starts and stops water flow to compressor. Put such valves on inlet side, with outlet free to flow into an open funnel or sight glass.

Cooling water should enter cylinder or intercooler at bottom, leave from top. This keeps jackets full and helps eject any air. A check valve between cylinder and intercooler above it keeps water from draining back into cylinder when unit is shut down.

Extremely cold water may cause condensation on cylinder walls. This destroys lubricant, increases wear. To avoid this, pass cooling water through intercooler first, then to low- and high-pressure cylinders in turn.

Table II shows recommended water quantities. With them, temperature of air leaving intercooler or aftercooler will be within 20 and 15 F, respectively, of the temperature of water entering the cooler (for ordinary plant loads).

Use enough plugged fittings in water lines to cylinders and coolers to permit cleaning jackets and tubes with an air hose or with a caustic-soda solution.

I — Effect of Initial or Intake Temperature on Delivery of Air Compressors

(Based on a nominal intake temperature of 60F)

Initial temperature, F	*F, abs*	*Relative delivery*	*Initial temperature,* F	*F, abs*	*Relative delivery*
– 20	440	1.18	70	530	.980
– 10	450	1.155	80	540	.961
0	460	1.13	90	550	.944
10	470	1.104	100	560	.928
20	480	1.083	110	570	.912
30	490	1.061	120	580	.896
32	492	1.058	130	590	.880
40	500	1.040	140	600	.866
50	510	1.020	150	610	.852
60	520	1.00	160	620	.838

II — Cooling Water Recommended for Intercoolers, Cylinder Jackets, Aftercoolers

Gpm per 100 cfm actual free air

Intercooler separate	2.5 to 2.8
Intercooler and jackets in series	2.5 to 2.8
Aftercoolers:	
80-100 psi, 2-stage	1.25
80-100 psi, single-stage	1.8
Two-stage jackets alone (both)	0.8
Single-stage jackets:	
40 psi	0.6
60 psi	0.8
80 psi	1.1
100 psi	1.3

III — Typical Compressor Safety Devices

Name	*Function*
Relief valves	On compressor discharge side to relieve excessive pressure. Don't use any shut-off valves between compressor and the safety valve
Overspeed shutdown	Trips out drive when compressor exceeds predetermined safe speed
Oil-failure shutdown	For large compressors fitted with pressure lubrication, this device protects bearings by stopping unit when oil pressure fails for any reason
Jacket-water valve	Shuts down compressor if water pressure fails. It is operated by either pressure or temperature
Over-pressure shutdown	Stops compressor when discharge pressure goes above pre-set safe value
Excessive-temperature shutdown	For isolated compressors this gives protection against high discharge temperature by automatically stopping unit
Main-bearing protection	Thermal shutdown devices stop compressor if bearing temperature goes too high
Multistage temperature protection	Recording thermometers for each stage are good for this, give continuous reading of each stage's outlet temperature

TROUBLE-SHOOTING GUIDE

Water-Cooled Compressors

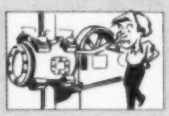
DISCHARGE PRESSURE LOW — demand greater than compressor's capacity; rings worn; leaky packing; wrong speed; excessive leakage in system

NOT ENOUGH CAPACITY — too much leakage in piping or valves; discharge pressure too high; wrong speed; clogged filter; worn piston and rings

COMPRESSOR DOESN'T DELIVER AIR — dirty intake filter; suction line clogged; improperly installed valves; strips missing from compressor valves

EXCESSIVE COMPRESSOR VIBRATION — unit not properly secured to foundation; wrong type of foundation; piping not correctly supported

COMPRESSOR OVERHEATS — broken valve strips; not enough cooling water; air-intake filter clogged; discharge pressure too high; internal leakage

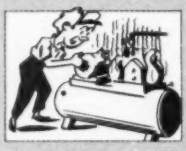


COMPRESSOR OVERLOADS MOTOR — belts in drive too tight; discharge pressure or speed too high; discharge line clogged; wrong motor hookup

COMPRESSOR KNOCKS — loose flywheel or pulley; too much clearance in wrist-pin bushing, crankpin or main bearings; loose valve or piston nut

Air-Cooled Compressors

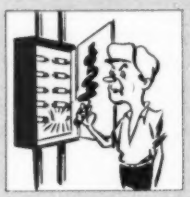
NOT ENOUGH CAPACITY — excessive leakage in pipes, fittings or valves; discharge pressure too high; wrong speed; clogged intake filter; worn piston and rings; leaky cylinder-head gasket; belt slips; intercooler leaks



COMPRESSOR OVERHEATS — valve strips broken; direction of rotation wrong; intake filter clogged; discharge pressure too high; internal leakage; not enough lubricating oil

COMPRESSOR KNOCKS — loose flywheel or pulley; loose valve in cylinder or loose unloader; excessive end play in motor rotor; too much wrist-pin- or crankpin-bearing clearance; belt not aligned; unlevel mounting

EXCESSIVE COMPRESSOR VIBRATION — unit not properly secured to foundation; wrong foundation; shipping blocks not removed from under base; motor rotor out of balance; one cylinder in a 2-cylinder unit not working



UNIT BLOWS FUSES — fuses too small; low voltage; pressure-switch differential too small; unit starting against a full load; motor defective; compressor or motor binding

Operation & Maintenance

Your best guide to compressor operation and maintenance is the manufacturer's book. Too many operators file instruction books when they arrive and then promptly forget them. This is just too bad, because compressor builders put much time, energy and money into producing usable books that will answer most of your questions.

Start by following carefully the installation instructions for your compressor and its auxiliaries. A job that's installed right saves you many future headaches and insures topnotch performance.

Once a compressor is on the line and working right, regular inspection, lubrication and overhaul are chores that pay big dividends if done well. Here again, your best guide is the instruction book. It deals with your compressor exclusively, and is based on long experience.

Lastly, remember that many steps taken during system planning have direct effects on operation and maintenance. So plan your system well, working with a consulting engineer and the manufacturer whose compressor you intend to use.

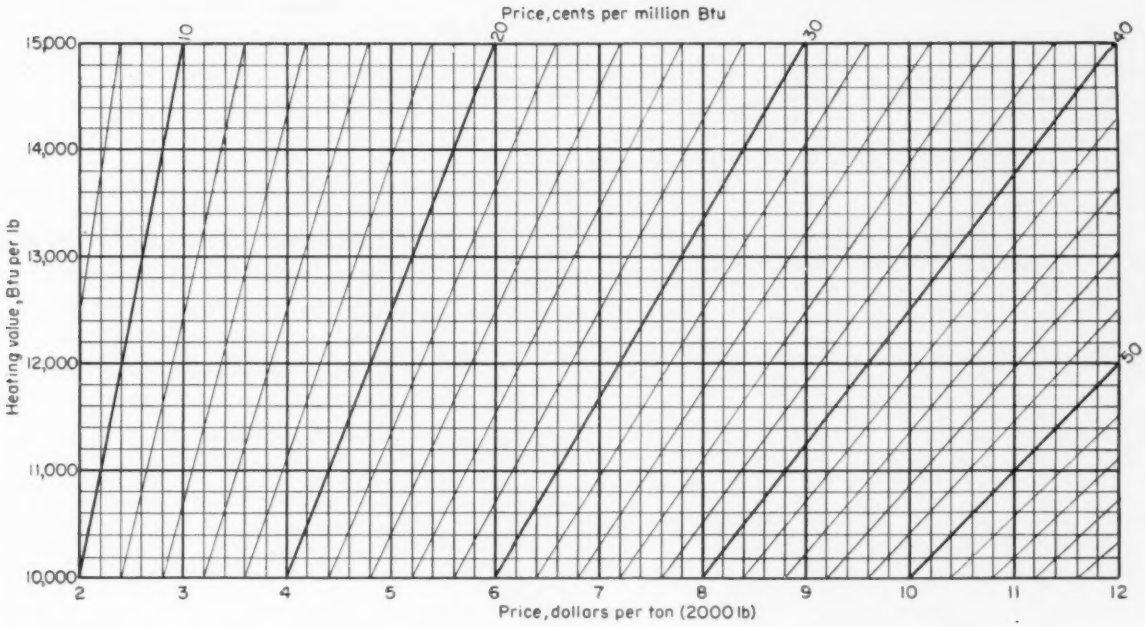
If you live by these simple rules, troubles will be rare. If they do pop up, use the trouble-shooting hints above to give you a lead. Then turn to your instruction book for detailed information on cures.

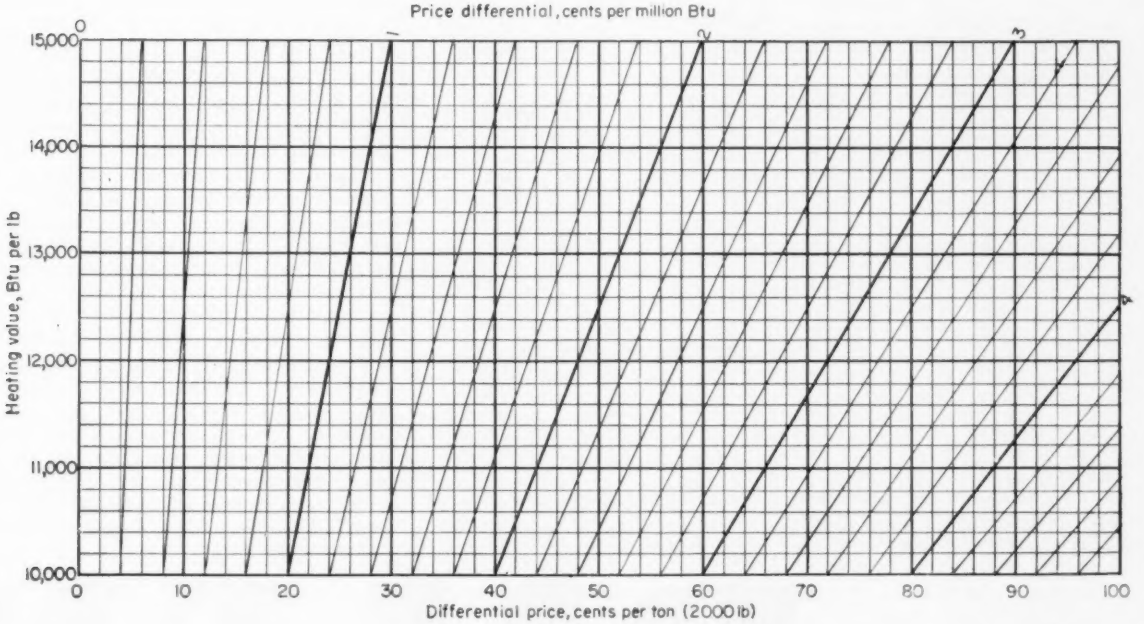
ACKNOWLEDGMENTS

For illustrations and technical data in this handbook, POWER is indebted to the following manufacturers: R P Adams Co, Inc; Aftercooler Engrg Co; Air-Flo Compressor Co; Air Maze Corp; Allis-Chalmers Mfg Co; V D Anderson Co; American Air Filter Co, Inc; American Blower Corp; Armstrong Machine Works; J B Beaird Co, Inc; Beach-Russ Co; Binks Mfg Co; Brown Boveri Corp; Brunner Mfg Co; Buckeye Air Compressor Co; Bury Compressor Co; Carrier Corp; Champion Pneumatic Machinery Co; Chicago Pneumatic Tool Co; Clark Bros Co; Clark Mfg Co; Cooper-Bessemer Corp; The Cornelius Co; Curtis Mfg Co; Davey Compressor Co; DeLaval Steam Turbine Co; DeVilbiss Co; Dollinger Corp; Eclipse Fuel Engrg Co; Elliott Co; H Emerson Thomas & Assoc; Fuller Co; Gardner-Denver Co; Gast Mfg Co; Gray Co, Inc; Hankison Corp; Ingersoll-Rand Co; Jaeger Machine Co; Joy Mfg Co; Kaye & MacDonald Inc; Kellogg Div, American Brake Shoe Co; Lamson Corp; Le Roi Co; Nash Engrg Co; Niagara Blower Co; W H Nicholson & Co; Nordberg Mfg Co; Norwalk Co; OK Clutch & Machinery Co; Pennsylvania Pump & Compressor Co; Quincy Compressor Co; Roots-Connersville Blower Corp; Sarco Co, Inc; Schramm, Inc; Spencer Turbine Co; C E Squires Co, Inc; Standard Stoker Co; Strong, Carlisle & Hammond Co; Swartwout Co; Trane Co; Union Steam Pump Co; U. S. Hoffman Machinery Corp; Voss Machine Wks; Wayne Pump Co; Westinghouse Electric Corp, Sturtevant Div; Wilkerson Corp; Worthington Corp; Wright-Austin Co; Yeomans Bros Co; York Corp.

Power's DATA SHEET

No. 252





Figuring Coal Costs

► THESE CHARTS help convert coal prices per ton into cents per million Btu so fuels of different heating value may be compared.

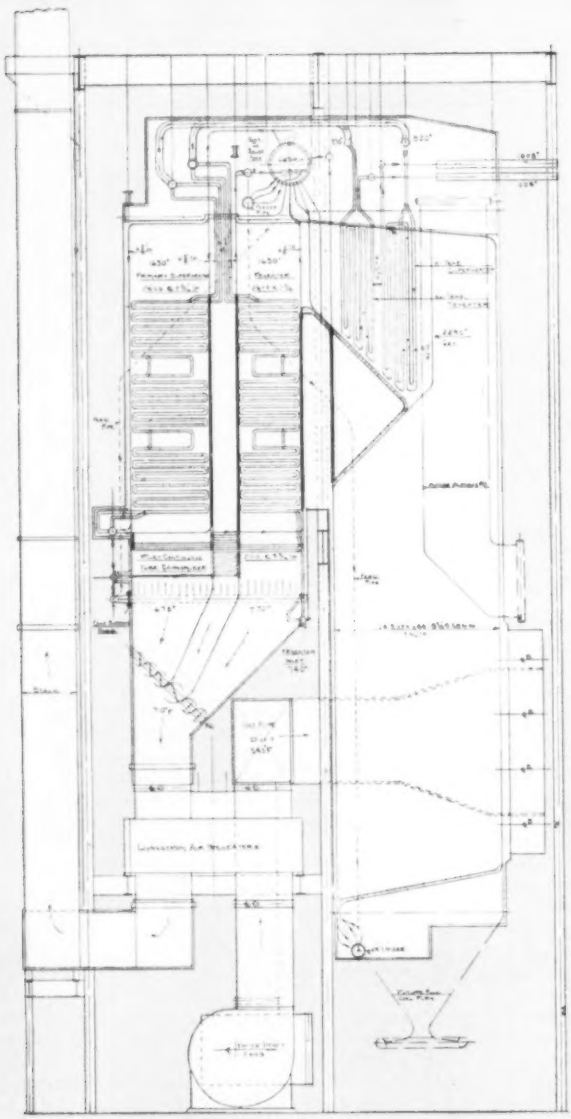
Example: Find the Btu cost of coal listed at $6 per ton if it has a heating value of 12,000 Btu per lb. In *upper* graph, find $6 on horizontal scale. Read up to intersect 12,000 Btu line. Between slanted lines read 25 cents per million Btu.

Example: Coal A, 13,000 Btu per lb, costs 2c per million Btu more than coal B, 12,000 Btu per lb. In *lower graph* find the slant line for 2c, follow down to intersect with 13,000 Btu to read 52c per ton on lower scale. This means A is 52c too high to equal cost of B. Conversely, find intersection of 2c with 12,000 Btu to read 48c per ton. This means B could rise 48c to equal cost of coal A.

C W STEVENS *Dayton, Ohio*

© POWER

TEXAS GOES FOR RILEY



RILEY REHEAT UNITS
recently purchased by
TEXAS ELECTRIC SERVICE CO.
DALLAS POWER & LIGHT CO.
HOUSTON LIGHTING & POWER CO.

Capacity—1,250,000 lbs./hr.
Design Pressure—2125 psig
Superheater Outlet Pressure—1925 psig
Steam Temperature—1005°F.
Reheater Capacity—1,148,000 lbs./hr.
Reheater Outlet Pressure—470 psig
Reheater Temperature—1005°F.
Efficiency, Gas Firing—83.7 %
Pressurized Furnace
Fired by Gas—Oil Standby
Designed for future conversion to lignite firing
Ebasco Services, Inc., *Engineers*

Method of Steam and Reheat Temperature Control

Steam temperature is maintained constant between 900,000 and 1,250,000 lbs./hr. and reheater temperature between 825,000 and 1,148,000 lbs./hr. by means of gas flow control dampers.

Gas flows over superheater and reheater primary surface are automatically controlled by dampers located below the economizer. This provides definite control of both steam and reheat temperatures. The flow of gases over superheater and reheat surface is proportioned to give the desired temperature of 1005°F. from each.

At high loads where the quantity of gas passing over superheater and reheater surfaces would give higher than desired temperature, part of the gas is by-passed through the open lane between superheater and reheater surfaces. Note that the quantity of economizer surface in the by-pass line is greater to give approximately uniform economizer exit gases.

RILEY
STOKER CORPORATION, WORCESTER, MASS.
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

REHEAT UNITS IN A BIG WAY

★ TEXAS ELECTRIC SERVICES CO.
★ DALLAS POWER & LIGHT CO.
★ HOUSTON LIGHTING & POWER CO.

all have recently ordered 1,250,000 lbs./hr., 2125 design pressure, 1005°F. steam temperature and 1005°F. reheat temperature Riley steam generating units. These will be the first gas-fired reheat units to be installed in Texas.

While the Riley units purchased by Texas Electric Service Company and Dallas Power and Light Company are the first Riley units ordered by these companies, the two 1,250,000 lbs./hr. Riley reheat units purchased by Houston Lighting and Power Company will be the tenth and eleventh Riley units installed by them since 1938 and will give Houston over 7,000,000 pounds per hour capacity of Riley units.

When such a large public utility company places ten different orders with Riley extending over a 15-year period, isn't that conclusive evidence that Riley is a good company to do business with, that the performance of Riley equipment has been entirely satisfactory and that Riley gives their customers their money's worth.

It will pay you to investigate Riley equipment and request a Riley proposal when you are considering steam generating or fuel burning equipment. Riley users will assure you that you can rely on Riley.

Other Riley Public Utility Installations

DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES, CALIFORNIA
1,200,000 lbs./hr. 2075 psig. 1000°F. and 1000°F. reheat.

LOUISIANA POWER & LIGHT CO.
1,000,000 lbs./hr. 1725 psig, 1005°F. and 1005°F. reheat.
Ebasco Services, *Engineers*

SOUTHWESTERN GAS & ELECTRIC CO.
630,000 lbs./hr. 1050 psig, 1005°F.
Sargent & Lundy, *Engineers*

MONONGAHELA POWER CO.
700,000 lbs./hr. 1050 psig, 905°F.
Sanderson & Porter, *Engineers*

UTAH POWER & LIGHT CO.
575,000 lbs./hr. 1700 psig, 1000°F. and 1000°F. reheat.
Bechtel Corp., *Engineers*

CENTRAL ILLINOIS LIGHT CO.
600,000 lbs./hr. 950 psig, 900°F.
Commonwealth Services, *Engineers*

NORTHERN STATES POWER CO.
385,000 lbs./hr. 1500 psig, 950°F.
Pioneer Service & Engineering, *Engineer*

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
460,000 lbs./hr. 1025 psig, 900°F.
Ford, Bacon & Davis, *Engineers*

THE POTOMAC EDISON CO.
700,000 lbs./hr. 1050 psig, 905°F.
Sanderson & Porter, *Engineers*

IOWA ELECTRIC LIGHT & POWER CO.
300,000 lbs./hr. 975 psig, 910°F.

GULF POWER CO.
325,000 lbs./hr. 1000 psig, 900°F.
Southern Services, *Engineers*

SOUTH CAROLINA GAS & ELECTRIC CO.
400,000 lbs./hr. 1475 psig, 955°F.
Gilbert Associates, *Engineers*

UTAH POWER & LIGHT CO.
620,000 lbs./hr. 1500 psig, 955°F.
Bechtel Corp., *Engineers*

IOWA-ILLINOIS GAS & ELECTRIC CO.
250,000 lbs./hr. 975 psig, 905°F.

PUBLIC SERVICE CO. OF INDIANA
400,000 lbs./hr. 1000 psig, 910°F.
Sargent & Lundy, *Engineers*

DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES, CALIFORNIA
825,000 lbs./hr. 1200 psig, 900°F.

ARKANSAS POWER AND LIGHT CO.
650,000 lbs./hr. 1050 psig, 905°F.
Ebasco Services, Inc., *Engineers*

UNION ELECTRIC CO. OF ILLINOIS
370,000 lbs./hr. 1000 psig, 905°F.

SOUTHWESTERN PUBLIC SERVICE CO.
330,000 lbs./hr. 1050 psig, 900°F.

CAROLINA POWER AND LIGHT CO.
330,000 lbs./hr. 1025 psig, 905°F.
Ebasco Services, Inc., *Engineers*

PENNSYLVANIA ELECTRIC CO.
300,000 lbs./hr. 975 psig, 900°F.
Burns-Roe, *Engineers*

OHIO EDISON CO.
225,000 lbs./hr. 925 psig, 900°F.
Commonwealth Services, *Engineers*

MISSISSIPPI POWER CO
230,000 lbs./hr. 975 psig, 860°F.
Southern Services, *Engineers*

WEST PENN POWER CO.
210,000 lbs./hr. 1000 psig, 910°F.
Sanderson & Porter, *Engineers*

INTERSTATE POWER CO.
200,000 lbs./hr. 725 psig, 910°F.
Sargent & Lundy, *Engineers*

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE *SAFE* GAUGE GLASS

PACKING Chesterton SERVICE

NEW PRESSURIZED SPRAGRIP

First Effective Treatment for V Belts

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.

WHERE TO BUY SONDERGLASS

Alabama
Young & Vann, Bir.
Ala. Mch. & Sup., Dothan
Turner Sup. Co., Mobile
Ala. Machy., Montgomery

Arizona
McConkey, Docker, Phnx.
Globe Hdw., Globe
Ariz. Mng. Sup., Prescott

Arkansas
Mill & Mine Sup., No. Little Rock

California
Valley Pipe & Sup., Fresno
Jefferson Sup., L. A.
Western Ind. Sup., Sacr.
Mission Pipe & Sup., San Diego
W. E. Mushet, S. F.

Connecticut
Hawley Hdw., Bridgpt.
W. S. Holman, Danbury
Cunningham Sup., Htfd.
Gordon Pkg. & Sup., New Haven
Abel Transmn., Plainville
M. J. Daley & Sons, Waterbury

Florida
Mine & Mill Sup., Lakeland
Cameron & Barkley, Tampa
Cameron & Barkley, Miami
Farquhar Mchy., Jcksnvl.
Pnscla. Mill Sup., Pnscla.

Georgia
Pye-Barker Sup., Atla.
S. Donald Fortson, Augusta
C. W. Farmer, Macon
Battey Mchy. Co., Rome
Savannah Ship Chand., Savannah
Ga. Hdw. & Sup., Albany
T. Horne Sup., Thmsvle.

Indiana
Indianapolis Belt & Sup., Indianapolis
Industrial Sup., Terre Haute

Illinois
Grt. Westn. Sup., Chicago

Kentucky
P. A. Vogel & Sons, Louisville

Kansas
Capital Iron Wks., Tpka.
Garst-Temple Sup., Wcha.

Louisiana
Peerless Sup., Shrvpt.
Ind. Hdw. & Sup., Baton Rouge
Standard Sup. & Hdw., New Orleans

Massachusetts
Fred C. McClean Sup., Springfield
Fall River Steam., F. R.

Maryland
Natl. Eng. Co., Baltimore

Michigan
Kenneth Anderson, Det.
I. W. Swift Co., Houghtn.

Minnesota
Goodin Co., Minn.

Mississippi
Gen. Sup. & Mch., Meridan

Missouri
L. C. Pensinger, Kan. City
Rubber Prod. Co., St. Louis

Nebraska
Interstate Mchy., Omaha

New Jersey
John Simmons Co., Newk.
Warren, Balderston, Tren.
A. & J. Friedman Sup., Passaic

New York
J. M. Warren, Troy
Chas. Millar & Son, Utica
Munaco Pkg. & Rub., New York City
Chas. Millar & Son, Binghamton
Burns Piping Sup., Syr.
B. F. Gilmour Co., Bklyn.
Root-Neal Co., Buffalo

North Carolina
Tidewater Sup., Asheville
Sykes Sup. Co., Burlgtn.
Bernhardt-Seagle, Lenoir
Currier-Withers, Mt. Airy
Carolina Rub. & Sup., New Bern
Noland Co., Winston-Salem
Textile Mill Sup., Charlotte

Ohio
Assoc. Sups., Sandusky
Zimmerman Pkg., Cinn.
M. J. Gibbons, Dayton
Ohio Pipe, Findlay

Oregon
Harris Sup. Co., Port.

Pennsylvania
E. Keeler Co., Williamsport
Paul B. Huyette, Phila.
Somers, Fitler & Todd, Pittsburgh
Reading Fdy. & Mch., Reading
Chas. B. Scott, Scranton
H. P. Weller Sup., Erie
Eastern Penn. Sup., Wilkes-Barre

Rhode Island
R. I. Sup., Providence

South Carolina
Sumter Mchy., Sumter
Allen & Webb, Charleston
Poe Hdw. & Sup., Grnvle.
Columbia Sup., Columbia

Tennessee
Dauer Prod., Chattanooga
Amer. Rad. & Stan., Sanitary, Memphis
C. M. McClung Co., Knoxville
John Bouchard Sons, Nashville

Texas
Hornsby Hvy. Hdw., Wichita Falls
The Murray Co., Dallas
Wells Mch. & Sup., Ft. Worth
Peden Iron & Steel, Hstn.

Utah
Schieren-Jarvis, Salt Lake

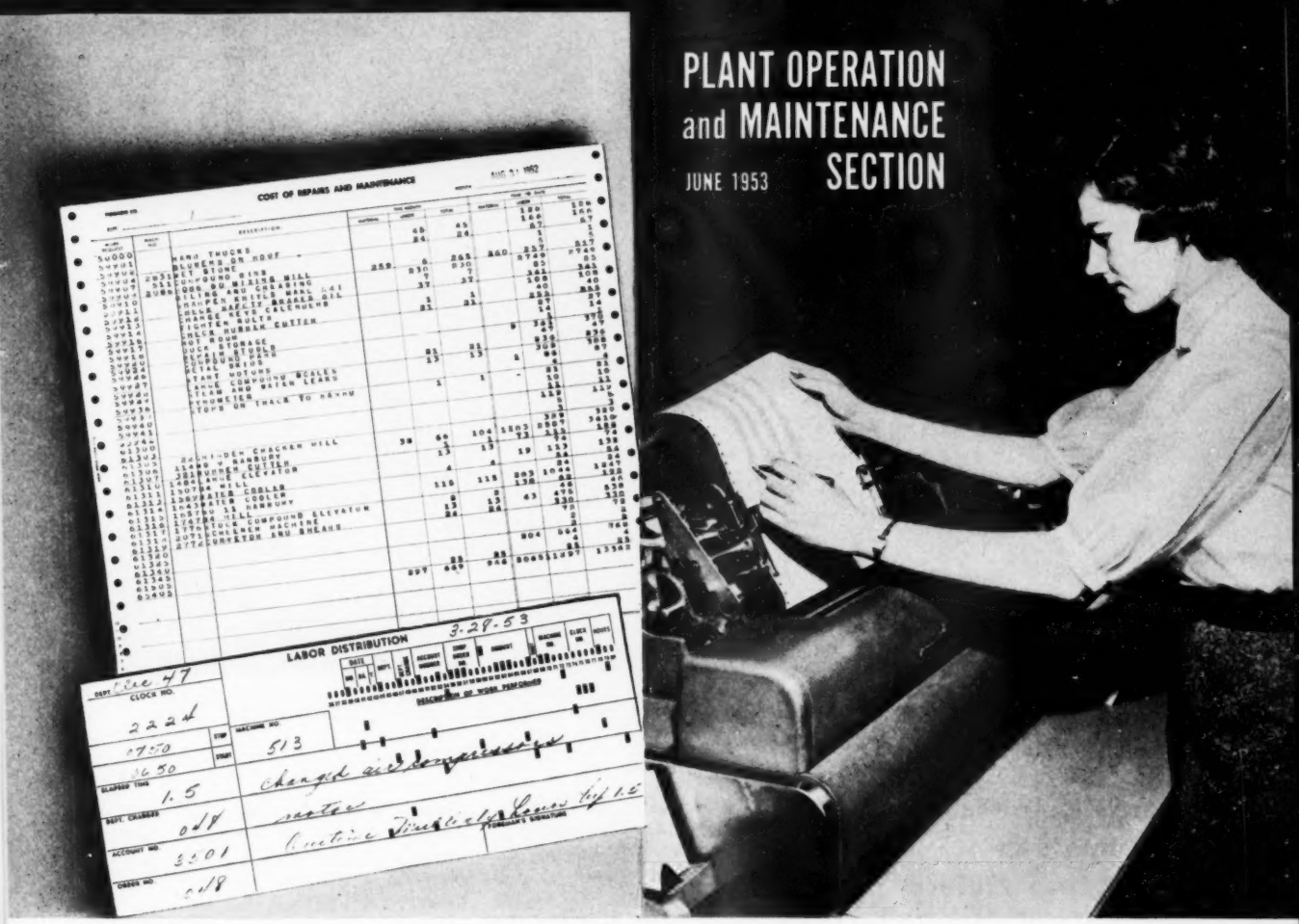
Virginia
Barker-Jennings, Lychbg.
A. Lynn Thomas, Norfolk
Industrial Sup., Richmond
Noland Co., Roanoke
Appomattox Iron Wks., Pittsburgh

Washington
Pollard & Co., Spokane
Steam Sup. & Rub., Seattle
Yakima Hdw. Co., Yakima
The Lloyd Co., Everett

Canada
Lytle Eng. Co., Montreal
Bell Marine, Pt. Colborne

A. W. CHESTERTON CO.
6 ASHLAND ST., EVERETT 49, MASS.

AMERICA'S OLDEST MANUFACTURER OF MECHANICAL PACKINGS



RECORDS for maintenance department, like the above, are quickly tabulated on this high-speed calculator by this girl

"Cards Slash Maintenance"

says Tharon J Ellis, Production Vice-President, Thermoid Corp

- **Spotlight is thrown on high maintenance costs**
- **Careless operating methods are found from cards**
- **Inefficient machinery is replaced because of records**
- **Incentive pay is higher—also employe morale**
- **Over 60% is saved on maintenance bookkeeping**

PLANT-MAINTENANCE COSTS are cut to the bone with accurate cost-accounting equipment at Thermoid Co, in Trenton, N. J. We had to adopt such a system because maintenance is complicated by the many items we manufacture.

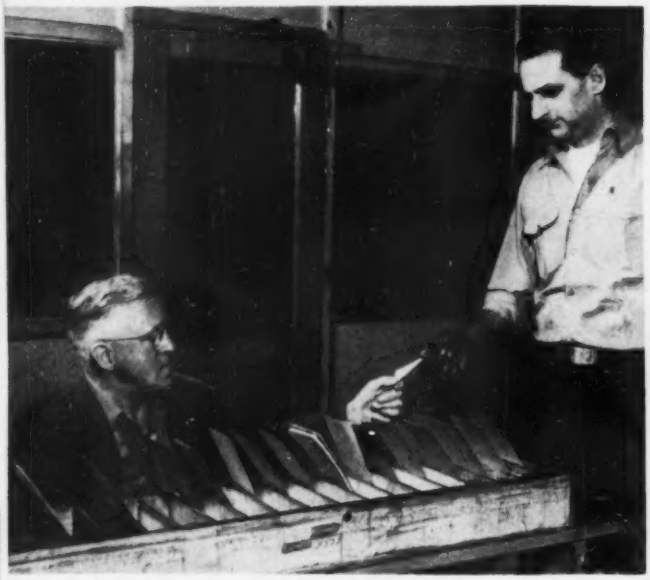
For 70 years we have made rubber products, such as conveyor belts, automotive and industrial hose, power-transmission belts, and miscellaneous molded-rubber products.

Other items have been gradually added until, today, industrial and automotive friction materials form a large part of production. Besides all this, our adjoining textile mill on 25 acres makes rubber-backed carpeting for automobiles. That all takes maintenance.

Card System. The key to successful maintenance is work assignment by time and material cards. And here is the system that helped solve our problems.

Foreman desiring maintenance or repair work phones the chief maintenance dispatcher. He gives dispatcher the machine number (each machine is tagged with a number) to be repaired. Dispatcher then makes up a time card for each job. Card shows machine number, order number, and clock number of maintenance man to perform the work.

Each maintenance man has in his own card box a bank of "work ahead" cards, from which he works. These are



1 Maintenance Foreman Jim Whitehurst gives labor-account card to Charley Layton. Card has all needed data for job

2 Job started, maintenance gang carry out instructions on card. With down-time jotted, card goes back to foreman

Records Help Find Weak Spots in Maintenance Picture

mostly routine, everyday jobs. "Rush" jobs are segregated from regular jobs. The maintenance man rings the time card "in" when he starts on the job. Then he rings "out" when he completes it. That shows exact time required for each job when completed.

This time card also shows material used. In this way we tie labor and material costs to each machine in each department. Maintenance-department clerk rechecks all cards for both labor and material.

From maintenance department, cards go to cost-accounting department. There labor and material costs are totaled.

Tabulating section gets cards next, where they are punched according to information written on them. Then tabulating equipment sorts cards and prepares the monthly summary. Maintenance cards for an entire month are punched, sorted by department and machine number, then tabulated in only three hours. That cuts down hours of bookkeeping and does job accurately, besides.

Copies of monthly summary are sent to vice-president in charge of production, plant engineer and division superintendents. Summary shows maintenance costs (both labor and materials) for the month, as they apply to each department and each machine in department. Also, cumulative costs for year to present date are shown for each

5 Plant Engineer Wm Hickey chats with Assistant A Jones about air compressor just installed. Monthly maintenance summary showed old unit cost too much for repair

6 T J Ellis checks monthly summary for overly high costs, goes into action

3 Next, all information on cards is converted to punched holes on this machine by girls in tabulating department

4 Punched cards are sorted by machine number, department, employe, etc, before being placed in final tab machine

department and each machine. These summary sheets give an over-all look at maintenance costs.

Using Data. What use is made of these data? Plenty. Here are some good examples.

1 Maintenance budget for the succeeding years is computed, with accurate, segregated maintenance costs for preceding year as a guide.

2 Summary, with cumulative totals, when compared with past performance, shows at glance costs that are out of line or unusually high by department and machine.

3 Data call attention to machines breaking down often. For instance, summary has shown maintenance unusually high on one press. Check showed that too many gasket changes were needed. Maintenance crew followed this up and found that press was slightly off-level. Releveling reduced gasket changes to normal. More important, over-all production from that press shot up as down-time for gasket changes nose-dived.

In another case a check for reason behind high maintenance costs on a production machine showed a worker was abusing the machine. Why? Because he didn't understand its operation. Careful instruction stopped the trouble after a few weeks.

Inquiry into high repair costs on another machine showed that work handled had increased and machine couldn't turn out capacity.

4 Our system of maintenance accounting has also proved useful for evaluating different maintenance methods. A program is now getting on with two Banbury mixers. These machines are used for breaking down and mixing certain ingredients into rubber. Main moving parts are two metal rotors revolving inside a shell. Wear between rotors and shell must be kept down because too much clearance results in poor mixing. And overhauling a Banbury costs about $19,000 per machine.

In the past, we did a major overhaul every seven years. Key to reduced wear lay in getting lubricating oil to rotors. Before, we checked rotors once a month. During 1952, we gave more careful attention to keeping oil lines clear, and made a check every week. Costs for this special maintenance were easily kept by card system. Then rotors were measured by micrometer at beginning and end of period.

During 1953, lubrication system on Banburys will be checked and cleaned only every two weeks. Micrometer measurements will again be taken.

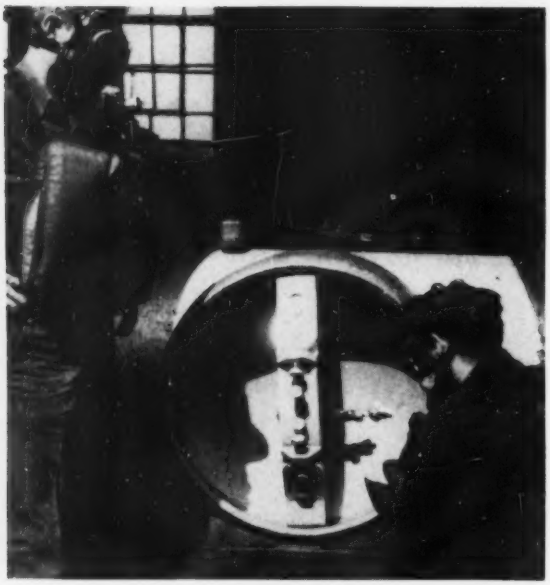
This one-week period is costing more than the old one-month period. Two-week period, at present, seems about right, but accumulating costs for one-week and two-week period over a year's time will leave little to guesswork. We'll then have accurate costs for setting a standard. This method for cutting down maintenance has also been used successfully in our power plant.

5 Performance of different types of machinery can be accurately evaluated. Cost summary showed last year, for instance, that cost of maintaining a hoist in wide use was too high, compared with cost of new one. We bought another type of same capacity. Costs accumulated over a period proved that new hoist took much less maintenance and saved us money. All old hoists are now being replaced with new. We know maintenance cost will be much less. Here again, our card system helped us spot our trouble.

6 Problem of knowing when to replace an old machine with new is simple. Accounting system gives accurate figures to management on maintenance costs. Purchasing provides costs on new equipment. A break-even point is determined. Further, soundness of each decision can easily be checked by referring to summarized figures in succeeding months. This does away with a lot of costly guesswork.

7 Intangible but real benefit is better employe morale. Like many companies, we pay workers on a wage-incentive plan. If a production machine is down, for example, premiums cannot be earned. Because there are fewer interruptions, production personnel now earn greater premiums.

For two years we have been keeping track of maintenance by this system. Tabulating equipment does many other accounting jobs, but it's a very important part of this program. And we save over 60% on maintenance bookkeeping for good measure.



Chlorine leakage presents a serious threat to any plant. There are certain tests you can run to check suspected leaks, but remember it takes specially trained men, properly safeguarded, to undertake all the corrective steps you may need

Fusible plugs, three in number, are installed in each end of chlorine cylinders to permit the tank to relieve pressure should chlorine become overheated. Repair crew, here, handles one plug by driving a tapered pin into it to stop leak

These Check Points Build Chlorine Safety

Here's a deadly gas that, properly handled, is a valuable condenser-maintenance aid. By following these suggestions you'll know the steps and equipment needed for best results

By **H J EICHENHOFER,** *Assistant Superintendent*
Pennsylvania Salt Manufacturing Co

► IN THE PAST 20 YEARS the productive capacity of chlorine has increased fourfold to meet the many uses industry finds for this gas. And with this wider use the Chlorine Institute, 50 East 41st St, New York, recognizes the need for a set of guides to permit safe handling.

Chlorine is a greenish-yellow gas that will not burn. It weighs 2½ times as much as a similar volume of air so that if it escapes from its shipping container, photos above, it settles close to the ground or seeks out low areas. Fortunately it gives off a pungent odor that serves as a warning of its presence. Left to itself chlorine gas can produce serious irritation of the lungs, throat and skin should it come in contact with a human being.

Usual power-plant duty for chlorine is the control of slime and algae in condenser water. The larger utility-power systems handle about 700 tons of liquid chlorine a year for this service. It is applied to the condenser circulating water in fairly standard equipment, designed specifically for this purpose. Manufacturers gladly furnish all needed details for operating their equipment. But most plant men will profit from these rules for safe handling of chlorine and its shipment containers.

A word about containers. *Never, never store them near combustible or flammable materials.* If possible segregate in a cool, dry storage space. Next protect them against external heat sources. Never apply heat directly to any container.

Before buying equipment, consider all safety angles in handling chlorine.

NINE GENERAL PRECAUTIONS

1. Fusible plugs are the safety devices on chlorine containers. They soften or melt at about 160 F, releasing contents to atmosphere. *Never* tamper with these plugs unless they leak.

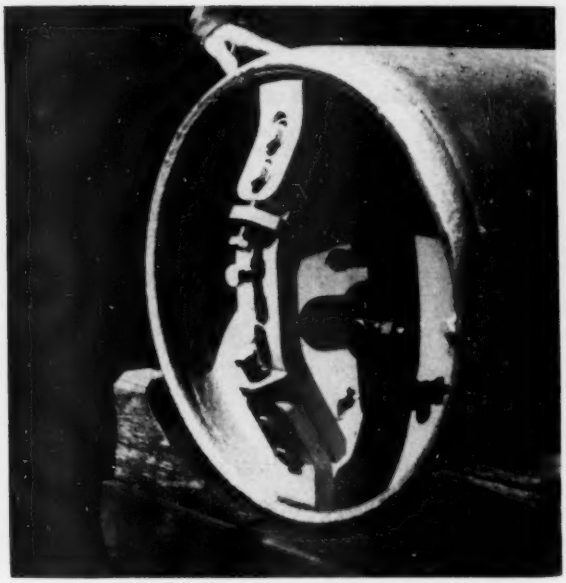
2. Open container valve slowly. Large wrenches or pipe wrenches damage it. One complete turn of valve stem counterclockwise (to left) opens valve enough to permit maximum discharge. Don't use wrench longer than six inches on container valve.

3. Stop usual gas leaks around valve stem by tightening packing nut.

4. To test for chlorine leak: Attach cloth to one end of stick, soak with ammonia water, apply to suspected area. If any chlorine gas leaks, a white ammonium-chloride cloud appears.

5. As soon as containers are empty.

Special wrenches have to be used in any work on chlorine tank-valve stem, packing nut and outlet cap. All tighten clockwise. In the shot above, the threaded plug that worked loose from a tapped cylinder is being tightened very carefully



Cylinder valves develop leaks of their own. Here's one solution — a metal cap covering the valve and then held in place by an adjustable bar. You can empty the cylinder by drawing chlorine out through the valve in the top of the cap

close their valves, disconnect, test valve outlets for chlorine leaks, as just described. If no leakage shows, apply cap nuts to valve outlets, attach valve protection hoods securely in proper places. Always keep fittings in place except when emptying container. Plug or cap the open end of line, leading from container, immediately to keep moisture from entering.

6. Discharge container at about 70-F room temperature. If gas-discharge rate from single container seems slow, get detailed info from supplier.

7. Cylinders of 150-lb capacity or less deliver chlorine gas when unloaded in upright position, and deliver liquid chlorine when unloaded in inverted position. Ton containers, photos, above, in horizontal position and with valves in vertical line (one above the other) deliver liquid chlorine from lower valve and chlorine gas from upper valve. Impress this on your operators.

8. If chlorine is being absorbed in a liquid, the liquid tends to suck back into the cylinder or container because a partial vacuum is created when cylinder or container becomes empty. Have your chlorine or equipment supplier check your plans and installation to make sure layout and construction make this danger impossible.

9. Always empty cylinders and ton containers on a scale, so you know at all times the amount of chlorine in the cylinder or ton container.

GAS PROPERTIES

1. Chlorine, as gas or liquid, is neither explosive nor flammable. In commerce it is classified as a liquefied gas under pressure, and as such exists in the shipping container as both a *liquid* and a *gas*.

2. Chlorine, as shipped, comes moisture free, and in this condition is noncorrosive to common metals. So you can ship it in steel containers. But with moisture, even the small amount in atmospheric air, chlorine becomes highly corrosive to most metals.

3. Dry chlorine at moderately high temperatures (given by some observers as beginning at 194 F) reacts with steel. Since this reaction gives off heat, it continues as long as the chlorine is in contact with heated steel.

4. Temperature affects both vapor pressure of chlorine in the container and volume of liquid chlorine. At 68 F, gage pressure of a chlorine container shows normally about 82 psi, at 100 F about 140 psi. Liquid chlorine in a container, loaded to its legal limit and at 68 F, occupies 88% of container's volume. At 100 F, it occupies about 92% of volume. At 153.4 F, container is liquid full. Above that, hydrostatic rupture may occur and endanger help.

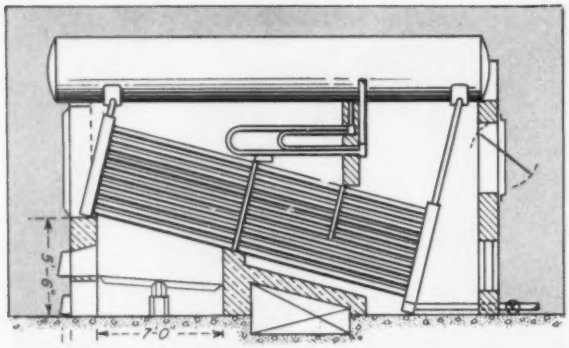
PROPER HANDLING

In general, trucking of cylinders requires no expensive equipment. Light, rubber-tired, 2-wheeled trucks with clamp support serve almost universally. Although you should avoid hoisting as much as possible, when it is necessary use a safe lifting clamp, not a magnet or sling. Never attach a lifting device to the hood. Its construction and attachment to the cylinder are not strong enough to handle safely the entire weight of a full cylinder.

Because of the size and the weight of ton containers, you need special equipment for unloading and transporting them to the storage or consuming point. Stationary or movable cranes, traveling overhead rail hoists, and specially fitted trucks in various combinations meet the particular needs of individual plants.

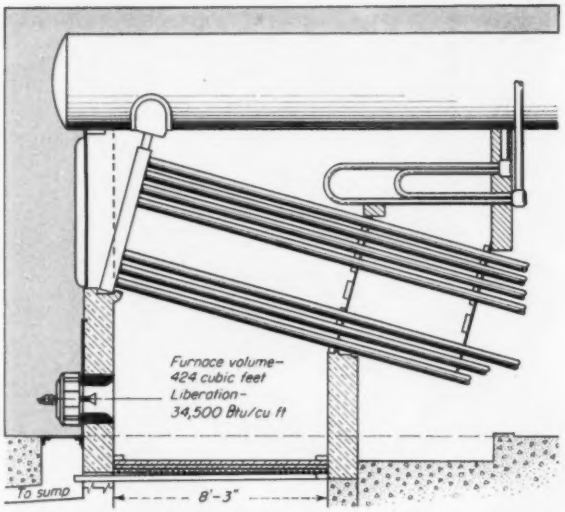
With ton containers, it is customary to use a lifting clamp or beam. This is practically standard in the industry. The chlorine supplier can furnish details.

Connect to the cylinder or ton container by use of the clamp and adapter, which the chlorine supplier usually provides. Flexible connections of suitable metal and construction do a good job in connecting the cylinder to the consumer's unloading lines. Unloading or conducting lines are usually of extra-heavy steel although wrought iron and copper can also be used. Pipe joints may be standard couplings, unions or flanges although standard ammonia-type flanges are preferred. Gaskets should be of compressed asbestos composition. Consult supplier on valve choice.



1 Battery of low-setting boilers suffered from ills of poor fuel availability, limited room for fuel handling, combustion

Any boiler change that pays its way in one year rates attention. Here's one that they said couldn't be done



2 Converted units, with greater furnace volume chiseled out of solid rock, permit smoke-free combustion of liquid fuel

Know-How Plus Planning Expands

By W GODLEY, *Manager, Contract Division Peabody Engineering Corp*

► When the Hotel Astor, New York City, decided to modernize its boiler room it had to overcome two objections that had hamstrung the decision for years. First, it was considered impractical and impossible to properly burn a fuel different from coal with the low boiler setting and small firebox the 50-yr-old steam generators had. Second, excavation under the boilers was out of the question because the floor was dangerously close to the underground-water level.

Despite these objections there were pressing reasons for improvements. Hotel steam load had grown to where it took 40 tons of coal daily to meet the demand. Trucks hauled coal in, dumped it on a belt conveyor, delivering to bunkers. A bucket crane pulled coal out of these bunkers, dropped it on the floor in front of the boilers. Here firemen came into the picture and shoveled it into the boilers.

Next step involved manual removal of hot ashes and clinkers, which were cooled by hosing down, right on the boiler-room floor. Wet ashes, shoveled into cans, were hauled back over coal in the bunkers to the ash hoist, and out to the street to be carted away.

With our experience, plus first-hand knowledge of oil-burning possibilities, we felt we could overcome the two stumbling blocks mentioned. What's more, the installation would pay for itself in a year. Furnace settings, Fig. 1, had to be changed no matter what. New York City's Bureau of Smoke Control, for example, expects furnace designs ample enough to hold heat release down to 35,000 Btu per cu ft at top firing capacities. The hotel certainly was not meeting this requirement with coal. Under the smoke ordinance any contemplated major alteration had to meet smoke-bureau regulations and, further, plans must be filed with and approved by the Smoke Dept. Similarly, the Fire Dept enforces its requirements.

Boiler-Room Plans. We drew up proposed alterations, Fig. 2, to meet these basic regulations. Then we laid out our plan for carrying out the work. The requirement of a larger furnace volume meant digging three feet deeper under each boiler, through solid rock. Next, we had to pull off the old air duct from the back of the boiler, so we could push back the bridgewall to make a longer furnace.

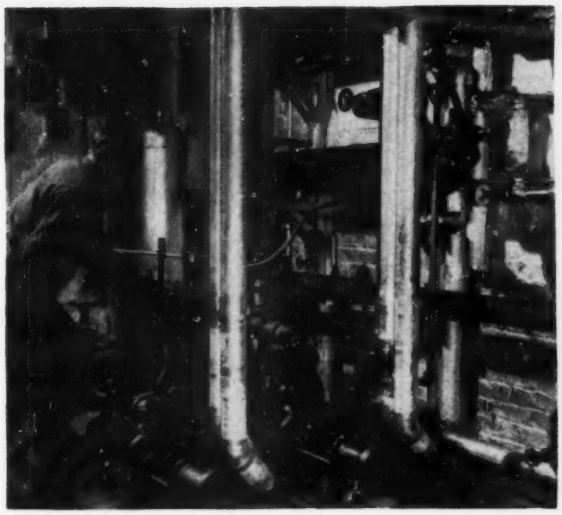
Prominent in our planning was the threat, when we excavated, of hitting water, such as concealed springs many predicted lay underneath. There was good reason for their belief because the old-boiler ashpits plus a few other boiler-room spots suffered from water seepage. To get around this threat we put in a trench, 18 in. wide, 3 ft deep, running along the front of the four old boilers with a spur connecting to a boiler-room sump.

The new furnace floor was to consist of a layer of hollow tile, with one course left off at the rear, and the front opened to the trench. Then, on top of the hollow tile, we'd lay a course of insulating bricks, and finally another two courses of first-quality Missouri firebrick.

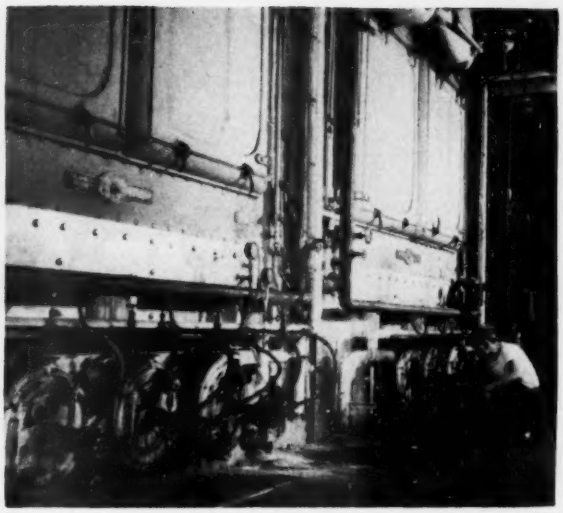
We agreed to have in place at least one 20,000-gal oil-storage tank, together with interconnecting piping, valves and fittings, pumping and heating equipment before we tackled the first boiler change. Automatic combustion controls were to go in and be ready as each boiler was completed.

Work Scheduling. When Harry Waite, the Astor's chief engineer, Bob Christenberry, its president, and Dr Muschenheim, chairman of the board, gave us the go-ahead, we started the first oil-storage tank installation. It went up in the existing coal bunker. So coal had to be shifted, and the overhead bucket-crane became a vital part of our equipment.

Only way we could get in steel for the tank's shell was via the ash hoist. Then we hauled it manually over the coal in the bunker to the first oil-tank location. Tank heads, rounded to meet New York City regulations, came in two pieces each and had to be welded on the



3 Special problem, due to cramped entry ways, was fuel pumping, heating set whose parts had to be assembled on job



4 New burner assemblies free boiler-room firing aisle of former coal-and-ash storage duties; promote tidiness

50-Year Boiler for Fuel Change

job. When finished the tank had to undergo and pass a hydrostatic test of 50 psi.

After this stage the oil heaters, temperature regulator, oil gage, together with fill, vent, oil suction, oil circulating, steam and condensate lines went in to complete the first step. Valved outlets were provided in the lines to connect piping to and from future tanks.

Oil pumping and heating equipment, Fig. 3, required special handling. Individual pieces had to be set up on the job to produce a compact and complete set because a preassembled unit would not fit through the boiler-room entrances. The finished set comprised three fuel-oil pumps, each capable of supplying full load, two steam-driven, one motor-driven; two steam-fuel heaters interconnected with the pumps and each capable of heating fuel oil to proper atomizing temperature; an electric heater for starting-up purposes; duplex suction and discharge strainers; plus all required reducing valves, temperature regulators, oversize air chambers for the steam pumps, pump governors, pressure and regulating valves, gages and thermometers.

Because the revamped boilers needed only to meet their nominal rating of 13,500 lb per hr of steam and the existing building stack gave ample natural draft, we selected natural draft, steam-atomizing burners, Fig. 4. They had cost advantages, besides developing a flame shape that fitted well in the newly planned furnace.

We were not to change the baffling. New sides and front walls were to be first-quality Missouri firebrick. But when we got into the actual relocation of the bridgewall and had to move the forward portion of the old air duct, the Astor's chief, Harry Waite, and our own gang decided it was best to pull out the entire duct and open up the boiler's second pass, Fig. 2.

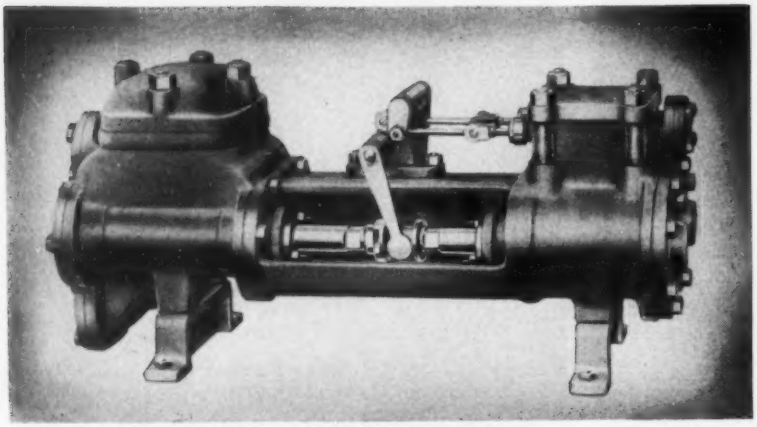
But even before this phase we had to go through special operations. Under the old coal-firing setup this air duct we just talked about ran across and under the boilers but behind the ashpit. It supplied the forced-draft air through chambers into each ashpit. Without it the boilers could never approach their rated output. In fact, the only time the load got low enough to carry it on natural draft was between 2:00 and 4:00 am. So we had to fit our boiler alterations to load needs. Here is how we got around these problems.

Boiler Work. First, we shut down the boiler farthest from the blower, and allowed it to cool. The remaining three carried the steam load. By 2:00 am when load slacked off enough to shut off the forced-draft blower, a small man crawled into the air duct of the down boilers and sealed off the duct with bricks and cement. Then we went ahead with that boiler's alterations. Once finished, we went through this same procedure, on down the line.

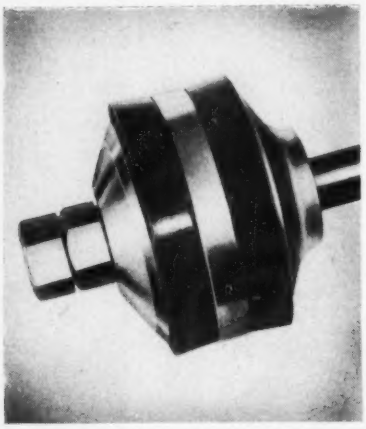
Fortunately, we'd expected water troubles and had dug an 18-in.-wide, 3-ft-deep drainage ditch. Once we pulled out the grates and took up the ashpit floors we met water. As we chiseled through the rock, still more came up, but the drainage ditch kept it moving. After we'd excavated to the desired point, Fig. 2, and the surface was reasonably dry, we laid down the furnace floor already described under Plans. Then we put up bridge and front walls and sidewall linings to complete the new furnace.

Our finished job, Fig. 2, gave a furnace volume of 424 cu ft, some 31 more than plans called for. At top capacity, heat release will run 34,500 Btu per cu ft, which promises low maintenance.

Operating Results. As each converted boiler came on the line, much old drudgery went out. Operating results picked up. Steam pressure held steady and at the proper level so immediate improvements were recorded in the laundry. All in all, the boiler-conversion job produced a number of direct savings. These savings, averaging $6815 per month from March through November, totaled $61,335. These figures indicate the installation will pay for itself out of savings in less than one year. And they said, "It couldn't be done."



1 Typical duplex direct-acting reciprocating steam pump for boiler-feed service. Units like this one find much use in plants of moderate and small size



2 Cup-type piston and packing for the liquid end of a reciprocating pump

Get Acquainted With That Hydraulic Work Horse: Reciprocating Feed Pump

► BOILER FEEDING is the commonest use for the well-known reciprocating steam pump. This unit has a piston in a steam cylinder on one end of a rod. At the other, or liquid, end is another but smaller-diameter piston. There's no crank action, hence the term *direct-acting*.

For steam rates of 100,000 lb per hr or less, and for boiler pressures below 300 psi, anyone needing a feed pump should consider this type.

Advantages. Pump has what you might call a built-in variable-speed drive. Simply closing or opening throttle valve adjusts pump capacity to match boiler load. This may be done manually or by automatic-control valves working from boiler pressure or water level, without electrical connections.

With good liquid-piston and rod packing, volumetric efficiency is about 96%. Even after much wear, volumetric losses are small. Wear seldom keeps this pump from delivering some capacity.

On most jobs, reciprocating pumps exhaust to plant heating system, process units, feed heaters or other equipment needing low-pressure steam. With this hookup the pump acts the same as a pressure-reducing valve. For small units (6-in. stroke or less) steam rate is low enough for atmospheric exhaust without excessive loss.

Application. Selecting right feed pump is simple because of relation between boiler pressure, pump discharge pressure and pump steam pressure. Steam from boiler drives pump, Fig. 3.

For average plant, pump discharge pressure is 15-20% higher than boiler pressure. This overcomes pipe friction and static head. Pipe friction and pressure drop through valves and fittings reduce steam pressure about 10% between boiler and pump cylinder. It's important to remember that regardless of boiler pressure, the pressure differentials remain fairly constant over range these pumps are applied.

This type's ability to work against a discharge pressure greater than the steam pressure depends on the difference in piston areas. Steam pressure times steam-piston area must create a force greater than liquid pressure, times liquid-piston area, *plus* mechanical friction. If, on feed service, there is a constant ratio between steam pressure and liquid discharge pressure, then *there is a constant ratio between steam-piston and liquid-piston areas.*

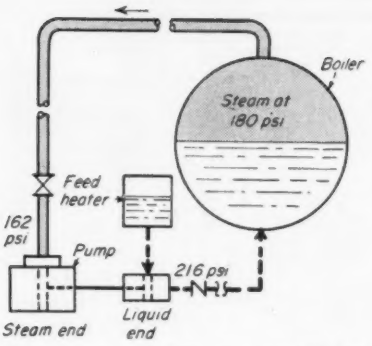
Consider Fig. 3 again. For a boiler pressure of 180 psi, pump should discharge at $180 + 0.2(180) = 216$ psi. Steam pressure at pump is about $180 - 0.1(180) = 162$ psi.

Now $A_L \times P_L = A_s \times P_s \times E$, where A_L = liquid-piston area, sq in.; P_L = liquid-piston pressure, psi A_s = steam-piston area, sq in.; P_s = steam pressure, psi; E = mechanical efficiency expressed as a decimal. Average pump with a 6-in. stroke has a mechanical efficiency of about 65%.

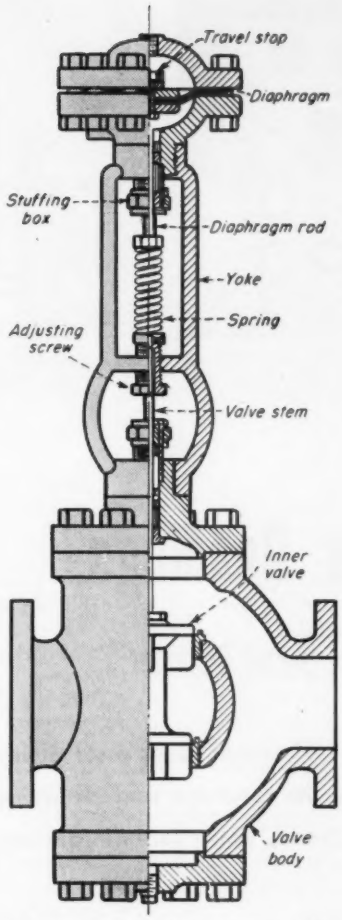
Inserting valves in this equation, $A_L\ (216) = A_s\ (162)\ (0.65)$, or $A_s \div A_L = 2$. This means the steam piston must have an area twice that of the liquid piston. Since area is a function of the square of the piston diameter, steam piston should have a diameter = $\sqrt{2}$, or 1.41 times that of liquid piston.

Today, most feed pumps have a diameter ratio close to this. Common pump sizes are 5¼ by 3¼ by 5; 6 by 4 by 6; and 10 by 7 by 10. First number is steam-piston diameter, second is liquid-end diameter, third is stroke, all in inches. If your pump has a diameter ratio of 1.41:1, or larger, it is sized right for boiler feeding.

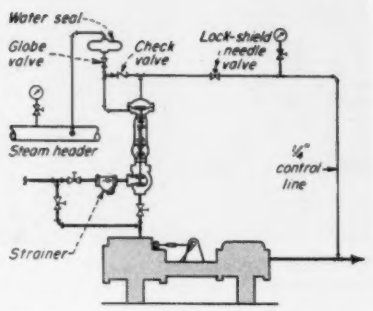
To choose liquid-end size for maximum capacity, pump builders use speed of liquid piston, ft per min, as their yardstick. Reciprocating pumps must fill with liquid on each suction stroke, or they won't work right. When pump runs too fast, liquid can't flow through lines and pump passages quickly enough to follow piston. With feedwater at or near boiling point, it's important that water follow piston to prevent flashing.



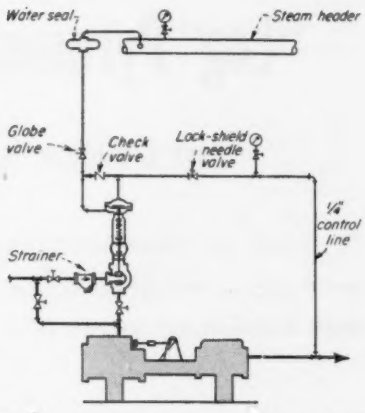
3 Pressure relations in a typical feed system using a reciprocating pump



4 Excess-pressure-type governor for a reciprocating steam pump for boilers



5 Connections for a pressure governor when steam line is below diaphragm



6 Connections for a pressure governor when steam line is above diaphragm

Maybe your plant has a berth for one or more of these rugged performers whose middle name is dependability. Here are your essential facts on use, installation, control

By **R K GROBHOLZ**, Application Engineer
Reciprocating Pump Division
Worthington Corp

Table shows a typical recommendation for maximum liquid-piston speeds in feed service. These are about 60% those for general service. Here's why:

1. Feed pumps run continuously except for scheduled shutdowns. Lower speed means longer life.

2. Water follows piston more readily at lower speeds; flashing is less likely to occur. Atmospheric pressure usually supplies suction head for pump handling cold water, at cold-water speeds. If hot-water pump runs at cold-water speed, suction head needed is the same. But suction head available is less because vapor pressure of heated water may nullify atmospheric pressure. Run hot-water pumps slowly to reduce needed suction head.

3. If boiler load increases somewhat, a minor speed change in an oversize pump is often enough to handle load rise without installing extra capacity.

For duplex pumps (two liquid pistons) $D_L = 3.5 \sqrt{\text{gpm/fpm}}$. For simplex pumps (one liquid piston) $D_L = 4.95 \sqrt{\text{gpm/fpm}}$. In both these equations, D_L = liquid-piston dia, in.; gpm = capacity needed, gallons per min; fpm = maximum piston speed, feet per min (from table above for stroke selected). See that combination of liquid-piston diameter and stroke fit the sizes listed in maker's catalog.

Piston Speeds for Boiler Feeding

Pump stroke, in.	3	4	5	6	7	8	10	12
Piston speed, ft per min	22	28	32	36	39	41	45	48

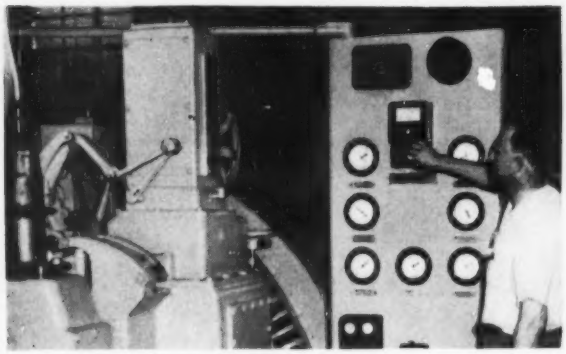
Fittings. Hot water is usually more corrosive than cold. So use bronze trim for liquid-end wearing parts contacting feedwater under 220 F. Usual designation for these pumps is *fully bronze fitted*. Bronze parts include liquid piston and rod, rod nuts, cylinder liner, valves, seats, stems, springs, stuffing-box bushing and gland.

At times feedwater is so heavily treated with caustic compound that bronze won't stand up. In these rare cases, all iron fittings may be best. But fully bronze-fitted pumps are suitable for most installations under 220 F.

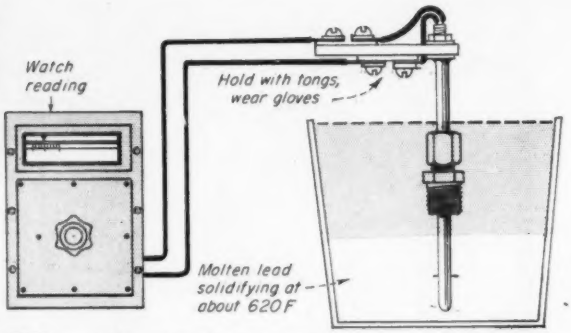
At about 220-F pumping temperature, bronze parts like piston rods and cylinder liners that take most wear may lose surface hardness, and score easily. This grows worse until pump leaks at stuffing box and past piston packing. For water over 220 F, use 18-8 stainless steel or monel. Bronze liquid valves wear less than rods or liners, are good up to 275 F.

Same 220-F limitation is best for bronze liquid plungers on plunger-type pumps. Monel or stainless steel may be expensive and difficult to obtain for large parts. It's often cheaper to use

(*Continued on page* 234)



EXHAUST temperatures are quickly checked by this engineer from pyrometer installed on the control and alarm panel here



TEST pyrometer by placing thermocouple in pot of molten lead. Check reading when lead starts solidifying at 620 F

"Log Pyrometer Readings,"

says C Morgan Jones, Diesel Engineer,

". . . and end diesel mysteries. A pyrometer takes most guesswork out of trouble-shooting. Log its readings and do away with headaches." Here's how to "read," how to maintain one

► MAC ADMITS he knows more about diesel engines than anyone else. When I asked why he didn't log his individual cylinder temperatures, he said, "What's the use? I can tell how she's running by just looking at the stack, or feeling the exhaust headers."

What he didn't know was that individual exhaust-temperature readings often tip you off about trouble, long before exhaust smoke and touch method do. They might tell, for example, when water jackets need cleaning, or if fuel injection is early or late.

Operator naturally knows everything isn't OK when exhaust is smoky. Trouble might be one cylinder overloading from faulty injection. But one cylinder can be overloaded without engine smoking. How? Because combustion is completed in hot exhaust headers, where it does no good. Pyrometer will find that in a hurry.

Carbon builds up in combustion spaces of that cylinder, but may not be bad enough to smoke at once. In the meantime, if cylinder heads are lifted, Mac will be surprised and say, "Look at this. All other cylinders are clean and haven't smoked." So another mystery of diesel gossip starts going round. Then it's entered in the maintenance log book for posterity—to be thrown at some unsuspecting salesman. Exhaust pyrometer would have found this trouble also.

Again, if a cylinder shows a very high exhaust temperature, you might check fuel pump, injector, even the fuel, and still not find cause of high reading. Thinking everything is all right, you start engine, blaming pyrometer. Then you forget it, but before long you lose your plant. How could this happen?

Well, you should have checked liner and piston, also. Careful check shows first signs of scoring, causing overheating registered by pyrometer. No breakdown if this had been checked and lube-oil service overhauled.

THINGS TO CHECK

Scale can form in engine jackets if you don't keep water hardness to a minimum. It forms slowly and robs engine of its efficiency. Scale gathers slowly, but the exhaust pyrometer tells all about it. Temperature of cooling water might decrease as thin layer of scale prevents cylinder heat passing to cooling water. But gradual increase for all cylinders tips you off to need of a descaling job.

Quick check of 2-cycle engine's cooling system without draining is to take off air-box hand doors. Then bar engine over slowly. Check rings with a strong flashlight as they slowly pass ports. First blackened ring that passes marks lowest point blowby has reached. All rings should be polished. Stop barring, push ring with wooden wedge. Ten to one, it will be stuck.

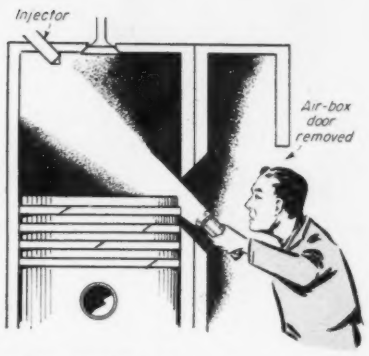
Lie on your back and shine torch upward through port. Then, as engine is jacked over, you can see carbon streamers on otherwise shiny liner. You can even see injector tip. Rings will be gummed from lack of oil. Lube oil burns off from high temperatures caused by poor cooling. Blowby might take place for whole length of piston, from crown to skirt edge, far as you can see.

Remove crankcase doors if 4-cycle engine. Don't jam clothing or yourself in webs while engine is barred over carefully. Piston skirt's bottom and liner's lower part can often be inspected for blowby indications, sketch.

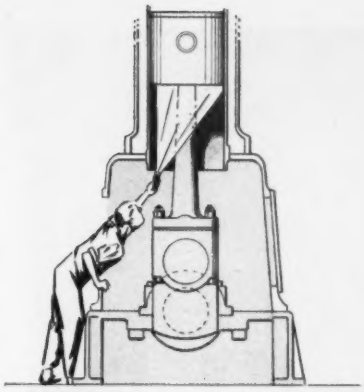
If blowby shows for liner's full length, smell the lube oil. It may reek of fuel oil. If so, take sample and place in tube, sketch. Take same amount of unused oil in another tube of same length and diameter. When both are same temperature, use two steel balls (ball bearings) of same weight, slightly smaller than tube.

Drop one ball into each tube, at same time. If ball in used sample sinks faster, oil is diluted. This test is very practical. The faster the ball travels in used oil, the greater the dilution.

Here again, carefully logged exhaust temperatures could have saved trouble. So keep an accurate log. Don't skip degrees and say reading is "about so and so." There must be no "about"—it must be exact to tell true story.



LOOK INSIDE cylinder through air box for signs of blowby, sticking rings, etc



FOUR-CYCLE liners are checked for blowby by looking up from inside crankcase

DILUTION TEST is made by comparing ball's travel through new and used oil

Take case of a 2-cycle engine where one cylinder does most work because it injects too much fuel. Pyrometer shows higher reading for this cylinder, but it's usually ignored. But trouble in this cylinder can spread to others.

As overheating from overload continues, carbon forms in ring grooves and combustion spaces. That distorts injection spray. Some nozzles also clog, so carbon builds up fast. Then carbon sticks exhaust ports. So cylinder works less on less air supply. More carbon forms, clogging ports. Then temperature soars as less air enters cylinder.

To maintain speed, governor advances fuel rack, causing other cylinders to respond. But large cylinder gets more fuel also. Then higher temperatures causes piston to drag and score.

More fuel is injected as governor tries to make up power loss. Other pistons strain and pull in response to throttle. Then these cylinders start overheating. Same cycle starts all over again. Combustion spaces carbon-up, rings stick, ports plug, fuel spray is distorted, and lube oil burns.

LOOK FOR TROUBLE

When engine is stopped, you find cylinder damaged and about to seize. But connecting rods may be damaged slightly, and other damaged parts may pass unnoticed. Don't kid yourself. Damage will show up—and how!

Late injection to any cylinder is easily found with a pyrometer. It means higher temperatures, incomplete combustion, carbonization. Early injection may cause detonation as piston passes through top dead center. Then pyrometer reading is low.

Briefly, a pyrometer showing high temperature also tells: (1) need for altering injection timing (2) need for reducing fuel supplied to any overloaded cylinder (3) if one cylinder is getting too much fuel. But if temperature is low, it shows: (1) need to advance injection (2) if rings or valves are leaking, or (3) if cylinder isn't getting enough fuel.

When temperatures are high in all cylinders: (1) engine is overloaded, or (2) exhaust backpressure is too high from muffler or silencer being plugged, or (3) exhaust turbine is dirty, or (4) exhaust piping is too long or small.

Pyrometer has only four parts: indicator, thermocouples, switch and extension wires. Indicator is actually small millivoltmeter.

Thermocouple for diesels is two wires of different metals; iron and constantan. Wires are welded together at one end, connected to indicator at other to serve all cylinders.

Welded end is "hot" junction, other "cold." When "hot" end is heated, a small voltage is generated. Voltage travels along wires through switch to indicator, where it's measured. But indicator scale is calibrated in degrees of temperature. Hotter the temperature, higher the reading.

To test, place thermometer at "cold" end (this end is at switch when alloy wire connects thermocouple to indicator, at thermocouple when wire is copper). Leave thermometer there for 40 to 60 minutes. Then take reading and compare with that given on indicator dial. If not same, adjust indicator with small knob or screw provided for this purpose. Indicators, fitted with cold-end compensators, need no adjusting.

If you know engine temperature is going up while pyrometer says it's going down, wires are reversed at switch connection or terminal. Reverse, and readings will be OK.

Set indicator dial at room temperature, not zero. And don't test indicator with dry battery or other power source. Smallest current slammed across terminals will damage coil, springs, and perhaps bend pointer. So be careful.

Thermocouple wires must not touch engine. Keep dry, and protect against vibration. If extension wires are of standard type, look for fraying at bends or at flexes.

Thermocouples are mounted in protecting tubes or "wells." For this purpose, seamless steel is preferred to wrought iron—steel responds to temperature changes quicker. Clean tubes at regular intervals. Don't scrape—wipe. Tips of thermocouples should project into center of exhaust header.

KEEP INDICATOR IN SHAPE

Indicators get sluggish from dirt. Clean with carbon tetrachloride. Don't adjust internally. Oil indicator bearings (often jeweled) with light machine oil on pipe cleaner.

Causes of pyrometer trouble are: damage to indicator, loose or broken contacts or connections, dirty contacts, grounded wiring. Fluctuating pointer indicates loose wiring. If connection between elements (iron and constantan) breaks, remake using electric welding.

Slightest rupture in wiring insulation means complete loss of current through grounding. If no reading, and insulation is all right, check for switch damage. Bypass switch with two short leads to indicator terminals.

Some indicators have simple locking device to short-circuit moving coil during transit. It's connected to terminal posts and must be removed before indicator can operate. Don't forget this when fitting a new one.

Check pyrometer's accuracy every year. Place thermocouple's welded-end in bath of molten lead. When lead is at point of solidifying, temperature is about 620 F. sketch on facing page. Compare reading with indicator's.

After years of trouble-shooting around diesels, both at sea and ashore, I have found that a pyrometer is one of the best investments an owner can make.

DUST FILTER is examined by plant engineer Lou Stark. This filter is ahead of the bank of activated carbon cells and keeps the carbon from being plugged with dust

HERE'S HEART OF ODOR-REMOVAL EQUIPMENT

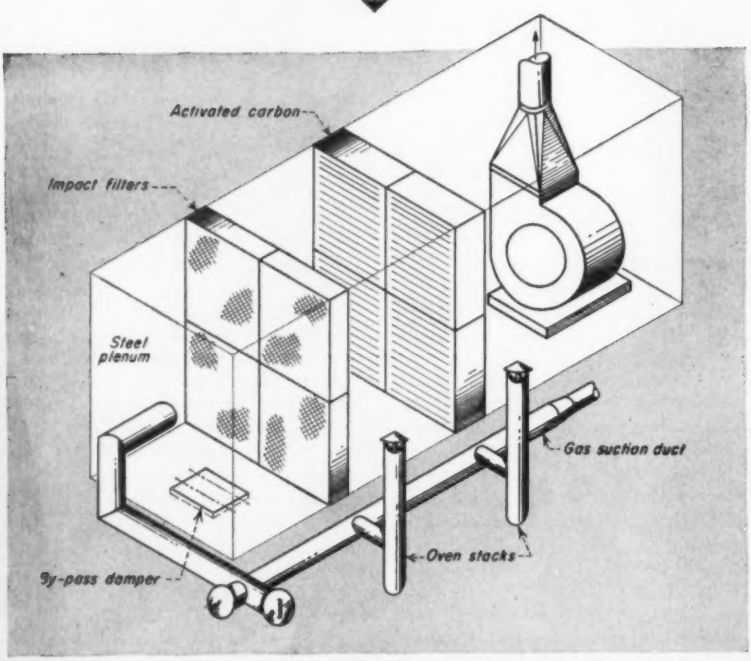
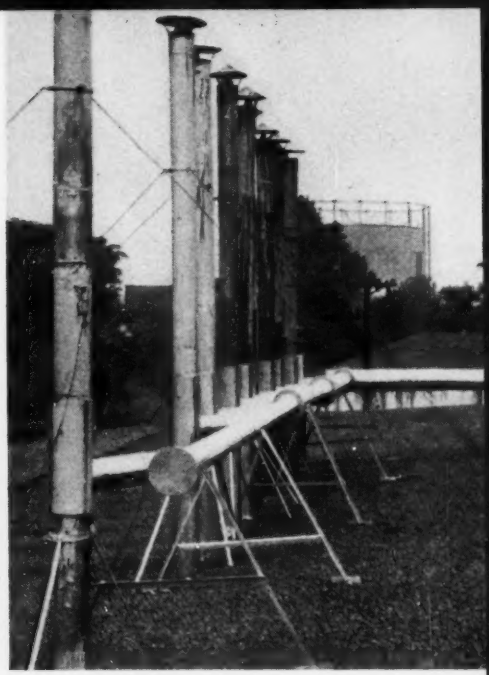


DIAGRAM SHOWS the layout for pressure blower, gas-suction duct, bypass damper, impact filter and cells of activated carbon. Above photo shows installation on roof



"SMELL" COLLECTOR atop wire-coating plant . . .

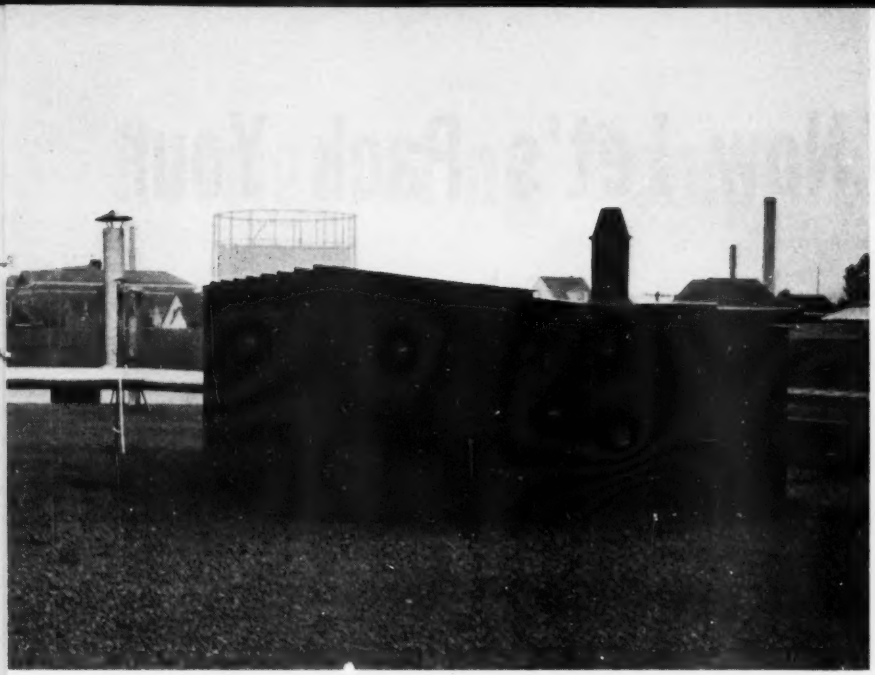
Exhaust

► INDUSTRIAL AND CHEMICAL plants relocated in suburban or semi-rural residential areas often find that they unwittingly create air-pollution problems. How? By discharging their process gases to the surrounding atmosphere. The Ace Wire Mill, Inc, Paterson, N. J. had such a problem.

This company manufactures copper transformer wire coated with synthetic lacquer, baked on after an immersion bath. Ovens are arranged in tandem with individual stacks venting to the atmosphere. Baking temperatures are about 650 F, to burn off all combustible gases and most of the solids in lacquer solvents.

Soon after plant was completed, stack effluvia was found to contain some odorous noncombustible gases and solids. These were causing a serious neighborhood nuisance. At the time, the management decided to install catalytic burners at the discharge point of the oven combustion chamber. They hoped thus to eliminate odors by completely burning all effluent gases and solids.

But complaints continued, although a decrease in the odor level was noticed. Finally, the local health department brought the situation to a head by ad-



. . . is compact, takes little maintenance, and does the job of keeping neighbors happy

Problem—Solution

- ***Process gas discharged to atmosphere brought squawks in semi-residential area***
- ***Catalytic burners and carbon filters team up to remove effluent gases and solids to solve problem***
- ***Impingement dust filters installed before bank of carbon filters keep carbon clean***
- ***Now, with all ovens in operation, odor removal efficiency is more than 92%***

Nuisance Stopped in Wire Mill

By **JOHN BARTOL**, *Vice-President, W B Connor Engineering Co*

vising immediate and positive action.

Consultant. At this point the Ace Mills called in Kevin B Magee and Associates, consulting engineers of Hohokus, N. J. They were to decide best means of abating the nuisance at reasonable cost, and without interrupting or interfering with production. First approach to the problem was to obtain a qualitative analysis of the lacquers and solvents used. From this point it was determined that gases generated by the process were of a nature easily absorbed by activated carbon. Other methods for masking or "neutralizing" odors were, of course, considered. But each one was found to be unsatisfactory due to a combination of reasons. Among the reasons, were excessive weight, bulkiness, cost, and complicated control and operation.

Next step was finding the quantity of gases emitted by all the ovens operating at same time and continuously. This was found to be about 250 cfm. Since for optimum absorption efficiency, air passing through activated-carbon equipment should not exceed 118 F, this temperature was established as the maximum through the system.

Hence, it became necessary to dilute the stack gases with 5750 cfm of 95-F plant air. This was important because the 118-degree limit was not to be exceeded. And this, in turn, established 6000 cfm of the total air to be handled by the exhaust blower.

Another factor was the need of maintaining a slight negative pressure in the coating room. That prevents exfiltration through window and door cracks, causing contamination of outdoor air at street level. Here, care had to be taken so room pressure wasn't decreased to a point where stack draft through the ovens would be neutralized.

This took careful analysis of the equipment, as well as installation of stack, suction and bypass dampers with locking quadrants. This arrangement allows any desired mixture within the equipment's temperature limits.

Impingement dust filters of the cleanable-metal type were installed before the bank of carbon filters. They remove air-borne particles and thus prevent clogging of the filter media. Result was that when system was placed in operation after needed adjustments, with all ovens in running operation, odor removal efficiency was more than 92%.

In this case, combination of catalytic burners and carbon filters did the job to everyone's satisfaction. Catalytic burners were helpful because they removed combustible matter, making load for carbon easier. That means less frequent reactivation of carbon and servicing of dust filters. And, at same time, burners prevent passage of gummy, unburned residue. This does happen in an improperly fired oven at times.

An incidental, but rather important, effect of the installation has been an increase in oven's efficiency from constant positive draft, maintained by blower suction on the stacks.

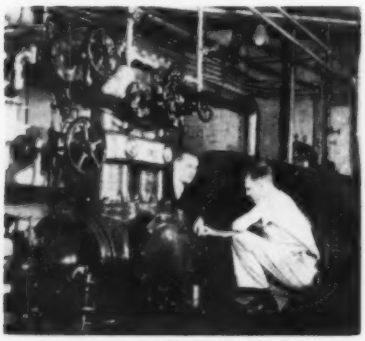
Structure for this unit was erected on the roof, but the location is not too important. It is necessary, however, to provide against excessive rise in ambient temperature inside the housing. This is important when equipment is in the open. Then you should insulate against sun with glass fiber or similar inorganic material, covered with proper membrane waterproofing protection.

In similar odor-eliminating installations the service life of the carbon (period between reactivations) will vary with nature of gases handled, length of oven's operation, and care with which catalysts are serviced. Life also varies with obvious factors of quantity or concentration of gases and over-all quality of workmanship.

OPERATORS' NOTEBOOK 64

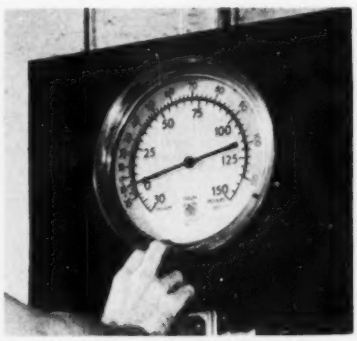
Now Let's Pack Your

Pump Down Low Side



1 Packing leaks costly refrigerant from large compressor, so Chief B Perham tells Jim Elder to remove it and repack

2 Low-side pressure of system is on the crankcase packing; so close king valve to keep refrigerant out of the low side

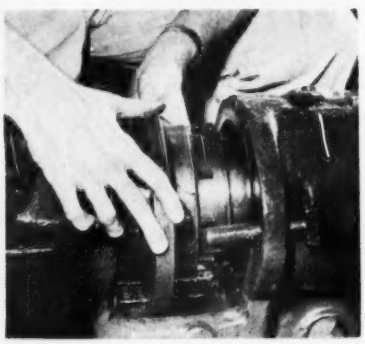


3 Run compressor, watch low-side gage until it gets down to slightly above zero. Tap the gage lightly with finger

Remove Old Packing

7 Before removing the packing gland, loosen oil line slightly so pressure inside crankcase equalizes with outside

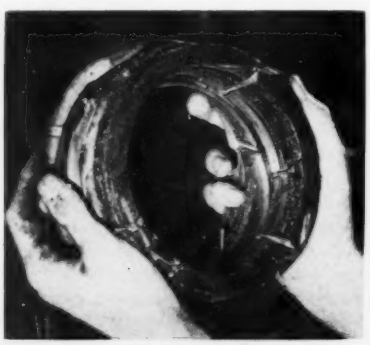
8 With pressure equalized, and no danger of refrigerant blowing out and injuring your eyes, remove oil filter



9 Remove packing gland nuts and slide gland along shaft far as it will go. Handle so small springs don't fly out

Put In New Packing

13 Clean shaft and box, make sure shaft is smooth all around. Oil the shaft through oil-line hole and gland end

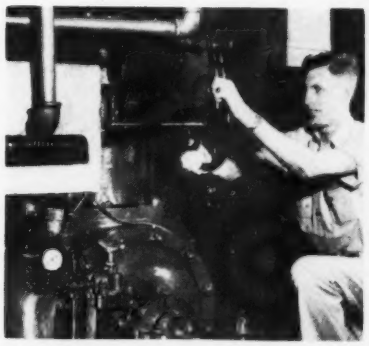


14 This packing set is made up specially for machine, of metallic rings and of flexible fiber rings to give compression

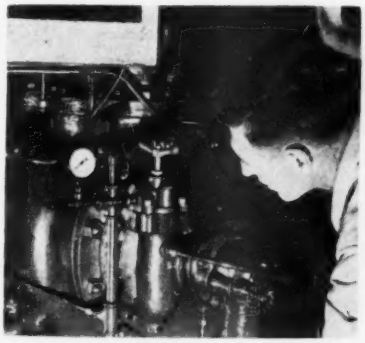
15 Metallic rings contact shaft, so dip each ring into oil. One metallic and one fiber-backing ring is shown on shaft

Refrigerating Compressor

By STEVE ELONKA,
Associate Editor



4 With pressure down to slightly above zero, so air does not leak into system, close suction valve on compressor



5 Watch crankcase pressure on oil gage for the refrigerant boiling out of oil and building pressure up slowly again

6 If pressure does not build up in the crankcase after watching gage for ten minutes, shut down the compressor

10 Old packing is flax against metallic rings. Remove flax with packing hook. But don't let hook burr shaft

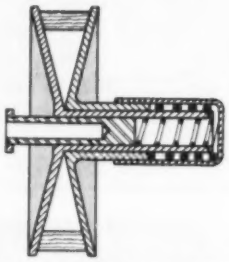
11 Slide lantern ring out, then take out packing turns in back of ring, right down to the end of stuffing box

12 Hold mirror and flashlight so you can see end of the stuffing box, all around, to check that no packing is left

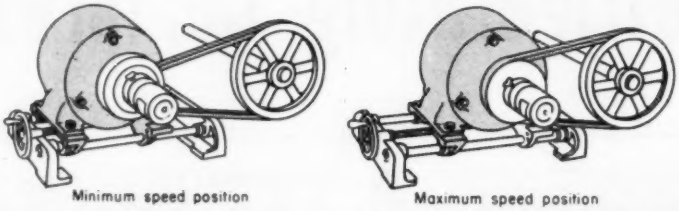
16 Ring has slot opposite gap so does not deform while placing over shaft. Open only enough to spread over shaft

17 Stagger gaps of metallic and fiber rings, slide into box. Follow with lantern ring, more packing. Use mirror

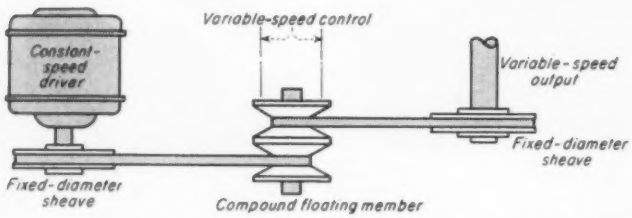
18 Before installing oil reservoir, check the position of lantern ring. Oil again, tighten gland and attach data tag



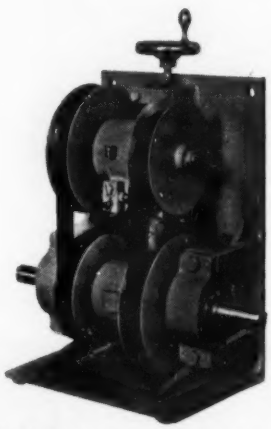
1 Spring pressure against sliding cones holds the V-belt snug at each setting



2 Here's how pulley type, Fig. 1, is applied on motor drive with adjustable base. Handwheel shifts motor position, changing effective diameter of driving sheave



5 Speed variation obtained by moving center line of the compound floating unit. Speed decreases as floater moves toward motor; increases in the other direction



6 Handwheel operates cams to vary the pitch diameters in the floating unit

Mechanical Variable-Speed Transmissions: II

By W L BYLER, *North Wales, Pa.*

Principles covered last month are applied here to commercial units. Constant motor speed is fed into each transmission, and speed varied mechanically. One such unit, plus a low-cost induction motor, may be answer to your variable-speed problem

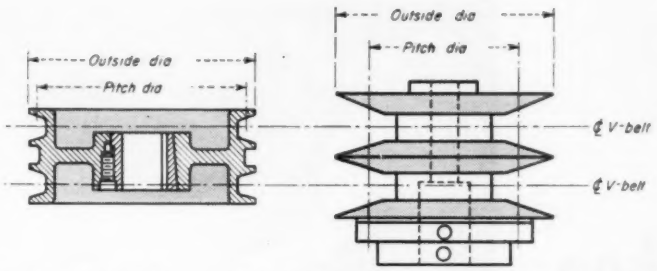
► COMMERCIAL VARIABLE-SPEED transmissions fall into four classifications: *variable-pitch pulleys, floating pulleys, all-metal types,* and *enclosed transmissions with variable cones.* The first three are discussed here. The fourth type, because of its wide scope and broad application, will be covered in a separate article.

Variable-pitch pulleys are one component of an assembly that includes an adjustable motor base, belt, and a companion sheave or pulley. One form of variable-pitch pulley uses a pair of spring-loaded cones over which a belt rides, Fig. 1. Moving the special motor base while drive is operating changes pitch diameter, Fig. 2. This action changes belt center-distance, forcing the spring-loaded cones to shift. It's this movement in cones that causes the change in pulley working-diameter; hence the change in speed ratio.

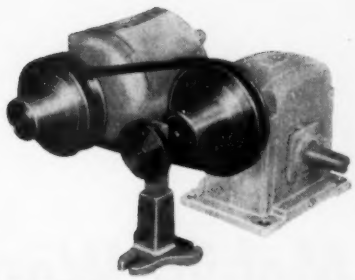
Most transmissions in this class have a fixed-diameter companion sheave. Units are available with one spring-loaded pulley and one variable pulley, Fig. 4. Ratio adjustment is made on the latter pulley, the spring-loaded pulley automatically adjusting to the proper pitch diameter.

Another form of motor pulley, Fig. 3, is really a multigrooved sheave using standard V-belts. There are two designs: One permits changing speed while the unit is operating, the other calls for adjustment while drive is at rest. Instead of the spring-loaded feature a threaded-sleeve combination does the trick. After sheave is adjusted to desired pitch diameter, motor base is set for proper belt tension. An automatic type is available using chains and sprockets to adjust sheave and motor base together, either manually or through a pilot-motor adjusting wheel.

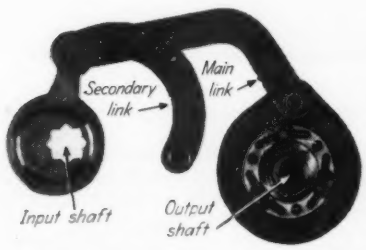
Floating pulleys vary speed by moving center line of a compound floating pulley away from, or toward, a fixed-diameter motor sheave, Fig. 5. When floating pulley is moved away from motor, the driving-belt tension increases. At the same time, the driven belt tension decreases. The increased belt tension on driver opens sheave on the



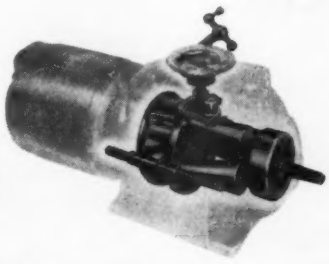
3 Speed varied here by manually adjusting pitch diameter on driver sheave. Motor position must be adjusted, manually or automatically, for proper belt tension



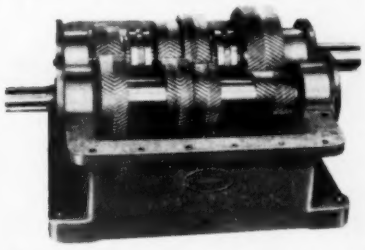
4 Fixed-center type uses one spring-loaded, one variable-diameter pulley



7 Secondary link varies effective throw of main link, changing output speed



8 Control ring engages tapered cones, meshing a sun gear on output shaft



9 Multispeed-gear unit gives several fixed rather than variable speeds

Characteristics of Variable-Speed Transmissions

	Type	Hp range	Speed range
1	**Variable motor-pulleys**		
	a Single spring-loaded	Fractional to 10	4:1
	b Tandem spring-loaded	½ to 7½	7:1
	c Automatically-adjustable V-belt	1¼ to 40	2:1
	d Manually-adjustable V-belt	1½ to 40	2:1
		To 300	1¼:1
2	**Floating pulleys**		
	a General type	Fractional to 5	10:1
		To 10	6:1
	b Enclosed, 4-pulley units	1 to 15	6:1
		1 to 3	10:1
		1	16:1
3	**All-metal types**		
	a Variable throw	1/30 to ¼ (reversing)	Infinite
	b Cones, ring and differential	1/15 to 3 (reversing)	Infinite
	Cones, ring and differential	1/15 to 5 (forward)	Infinite
	c Multispeed, change-gear	1 to 1500 (2 speeds)	5:1
		1 to 1300 (3 speeds)	5:1
		1 to 850 (4 speeds)	5:1

Note: The *enclosed variable-cone* type transmission, not included in above listing, will be discussed in a separate article next month.

driving side. And since sheaves have tapered sides, pitch diameter of driven side increases, raising the speed of output shaft. Reverse action takes place when the compound pulley is moved toward the motor. Remember that speed range must be sacrificed in both variable-pitch and floating pulleys as horsepower requirements go up.

Fig. 6 shows a variation of the floating pulley. Here, too, speed changes come about by moving center line of the compound pulley. However, the floating pulleys do not shift from difference in belt pressures but as result of cam action. Glance at the photo and note input and output shafts are in line.

All-metal transmissions fall into three major classes: (1) variable-throw (2) cone, ring and differential (3) change-gears. Change-gear transmission, Fig. 9, is useful when 2, 3 or 4 exact speeds are required. It is a multispeed rather than variable-speed unit and, therefore, will not be discussed further here.

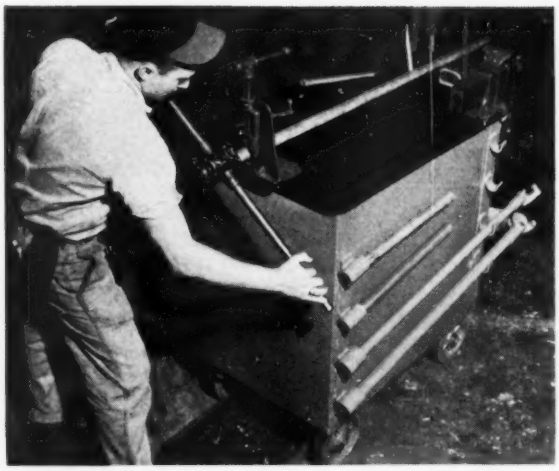
The variable-throw type, Fig. 7, has a cam-driven connecting rod that actuates a ratchet mechanism on output shaft. One such unit produces an output pulsating motion. But the commercial device available has a compound linkage. It consists of several basic units with a degree of overlapping, yielding a smooth and continuous output speed. This device, suitable for low-speed low-torque operations, may be used for gate-valve controls, liquid-level controls, and small fan drives.

Cones, ring and differential type, Fig. 8, use a tapered cone and a differential gear set. Most parts are metal and run in oil. The transmission is infinitely variable. Units are available for reversing service without changing direction of rotation of the drive motor.

Non-rotating member is a steel traction ring, which contacts tapered steel rollers at varying diameters. Driven speed is changed by moving this ring lengthwise of the transmission.

The rollers are the ball-bearing type, mounted in a carrier so their outer edges are held parallel to the central axis while, at the same time, contacting the ring at any point in its traverse. A fiber planet pinion, mounted on the end of each tapered cone, engages a steel internal sun gear. Traction pressure is obtained through metal-to-metal frictional contact between steel cones and steel ring. Output drive from the cones is through the differential gearing.

Mobile Workshop Speeds Electrical Construction



CONSTRUCTION RIG is true shop on wheels. Vises and conduit hickeys mount on outside; steel top doubles as work bench

Electricians don't go back for forgotten material when they wheel this construction rig into a department. Bill Krauss tells how to build this handy cabinet, what to put in it

STORAGE SPACE inside truck is ample for small parts and tools. Note the divided drawers, safety enclosure for snake

► ELECTRICAL DEPARTMENT at Charles Pfizer & Co's Brooklyn plant handles construction jobs with aid of the shop-made construction rig shown in these photos. It's easy for their electricians to carry all necessary tools and small parts to each job on the first trip. They never need to go back for a forgotten fuse, bolt or pipe threader. Rig is not used for maintenance, but only for construction.

Here are pointers from Bill Krauss, Electrical Engineer at Pfizer, on how to build the rig and what's in it.

How to Build. Framework is 1-in. angle iron, sheets are 16-gage steel. Top is ¼-in. plate, forming a working surface. Steel wheels and rubber-tired casters with ball bearings give the unit mobility. A handle permits easy pulling. Inside, segmented drawers and convenient shelves are arranged to hold needed equipment in easily-accessible manner.

A metal box for catching shavings and scrap fits underneath the truck. Operator puts it on the floor when he works, thus keeping litter from spreading over floor.

The ¼-in. plate on top of the truck serves as a base for both pipe vise and machinist's vise, see top photo. Conduit-bending hickeys fit on the side of the rig when not in use.

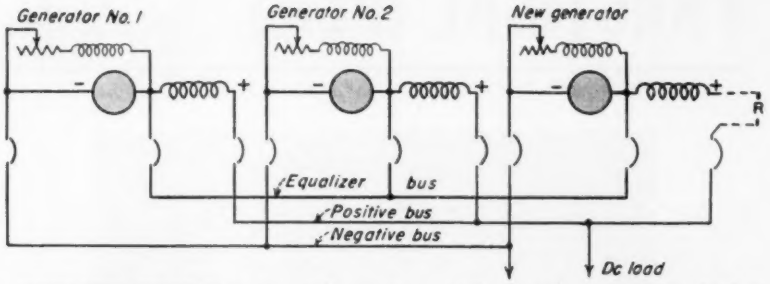
What Rig Holds. Drawer-space holds fuses, fuse testers, rubber and leather gloves, straps, sockets, wood and machine screws, bolts, nuts. Standard equipment includes an electric hammer, electric drill, hickeys for ½, ¾ and 1 in. conduit, plus sleeves so the electrician can control his bends. Pipe wrenches in sizes up to 2 ft are there, as well as a set of knock-out punches from ½ up to 2 in., and fuse pullers up to 600-amp size.

Snake is held in a safety enclosure to keep it from getting out of hand when plant electricians are pulling in wire. Truck provides space for trouble lamps, hacksaw, "DANGER! LIVE WIRE" sign, tape, tool box, pipe threader, etc.

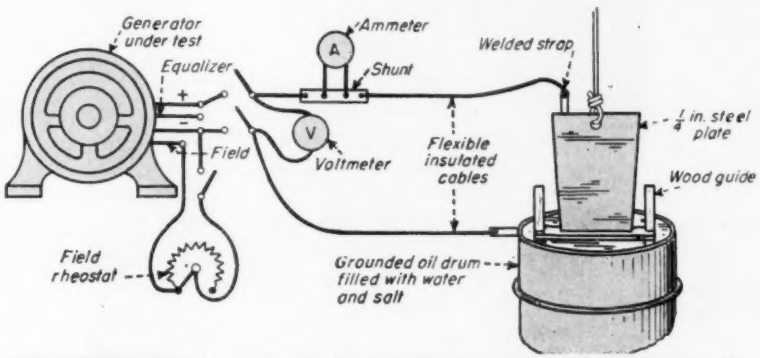
AREA AROUND TRUCK becomes job-site shop. With equipment at hand, fetching, carrying and waiting are cut to minimum

Paralleling Compound Generators

When this plant was enlarged, new generator failed to duplicate characteristics of two oldsters. Sergio Martinez had to run them in parallel. Here he tells how he did it



GENERATOR HOOKUP for parallel operation. Adding resistance to series field of new generator, *right*, made it possible to operate any two of the units in parallel



TEST PROCEDURE for obtaining regulation curve was to connect generator to waterbox with movable blade. Changing position of the blade changes load on generator

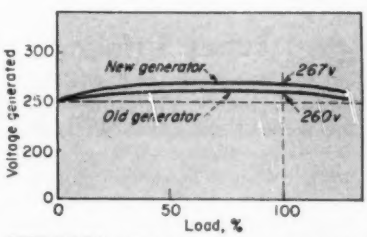
► FOR MANY YEARS, two compound dc generators at a Venezuelan plant had operated satisfactorily. They were synchronous-motor-driven units, each rated 300 kw, 250 v. One carried normal load, the other operated as a spare. But when two new boilers, a crane, etc, were added, the power plant needed a third generator, to operate two units in parallel most of the time.

New generator could not be ordered from the same manufacturer because of indefinite delivery due to a strike. So it was ordered from another company that promised to duplicate characteristics of the existing machines.

Hookup. Units were connected as shown on hookup diagram, with equalizer bus making a common connection on all the machines at the point between armature and the series field. With the same amount of compounding and the same no-load voltage they should have paralleled properly.

But when the new generator was run in parallel with either of the two older units, operators noticed the load would never divide evenly. New generator always carried a larger load than the old one. Sometimes difference was so great that the overload breaker of new unit would trip. This left the older machine with all the load, so it would trip too.

The chief engineer said unprintable things. Finally he was convinced that it was not an operational error, but that manufacturer had not duplicated curve of the existing generators.



TEST DATA point out that new generator had more compounding than older units

Had this been in the United States, manufacturer would have been notified that machine did not meet specifications and must be adjusted. But in Venezuela, there would have been a lot of red tape and several weeks delay before a service engineer could get here. So we decided to remedy the situation ourselves.

Test Procedure. First step was to obtain regulation curve for the old and new generators by measuring generated voltage at different loads, starting with a fixed no-load value. We could not use existing dc load since it varied constantly and would not stay steady long enough to read the meters accurately. To put different loads on the generators, we made a waterbox by filling an old oil drum with salt water. Two wooden guides kept the movable blade from touching the drum. Raising or lowering the blade changed the actual load.

Generator being tested was disconnected from the board and connected to the waterbox, see sketch. Test was made by varying the load and taking readings of current and voltage at regular intervals.

Because of its relatively low capacity, waterbox soon started boiling. This was not serious since each test took only a few minutes. We could have used several similar waterboxes in parallel, if desired.

Test results, see curves, show clearly that the new generator had too much compounding. Probable factory solution would have been to remove some turns from the series coils, but it was easier for us to insert a resistance in series with the series field, as shown dotted in the generator hookup diagram at top of page.

The resistance needed enough capacity to carry normal current of the machine. We used a loop made from regular copper bus bars. After this was installed the new generator operated satisfactorily with either of the old units, and divided the load evenly.

PRACTICAL IDEAS...*here's the trading post for your*

Disposing of Fluorescent Tubes Safely

DISPOSING OF used fluorescent tubes can be dangerous. There's always a chance that tubes will be broken by storing in some part of building. Broken tubes splinter and can cause serious injuries. People also get hurt while burying tubes at the dump.

Jerome H Coe of Pearl Harbor Naval Supply Center suggests an improvement over the usual method of pushing tubes through a hole in the side of a barrel.

Coe uses a cylindrical tube breaker with a conical base to funnel refuse into a steel barrel, photo. Breaking mechanism is made of two weights on short levers, mounted to swing freely on opposite sides of a shaft, rotated 250 to 300 rpm by a fan motor at 1100 rpm.

Water is piped to top through four sprinkler nozzles. Three fine nozzles provide mist throughout the machine. One large-volume lawn head supplies enough water to finish filling the barrel with water as it's filled with tube fragments.

Full barrels are removed with a finger lift. Then a patch is welded on the top without disturbing contents. Barrel is then stenciled:

Danger
Broken Fluorescent Tubes
Bury Without Opening

It is then hauled to the dump and buried.

About 230 four-foot-long tubes can be broken into one 55-gallon oil drum as fast as they can be fed into the machine. It breaks all tubes up to and including the 5-foot size.

Neoprene-Type Wires for Regulators

WHEN INSTALLING LINES to remote regulator stations, include several neoprene-type telephone wires. These can be used for control relaying, eliminating need for overhead. Newer neoprene-covered telephone wires come in 17 and 18 Awg and are practically identical in construction to regular control-type cable wires. These are handy sizes.

L FITZPATRICK *Jefferson City, Mo.*

Folding Shovel-Handle

WE INSTALLED a new boiler in place of the old hrt. New unit is about 8½ feet wide. We had to set it only 30 inches from other boiler. New job has two combustion-chamber clean-out doors. But there is only a 30-inch aisle between boilers, so problem was to clean out these chambers each week. Improving our regular ash scoop did the trick, sketch.

Fireman unfolds handle as he shoves scoop into ashes. He folds up handle as he withdraws scoop and carries ashes through aisle to wheelbarrow.

With this folding scoop, we don't have to wait until boiler is cold enough for a man to crawl in to remove soot and flyash. It sure solved our problem.

H C HECKMAN *Hermann, Mo.*

No More Magnetism

WE WERE ASSEMBLING a small ac solenoid-operated planisher with gravity return of armature to open position. Trouble was armature occasionally held closed because of residual magnetism. A spring return was impractical because of maintenance and not desirable because of power-stroke energy absorption.

A simple remedy not only solved problem but also gave increased switch life. Operating switch was shunted with a proper-size resistance to furnish only enough demagnetizing current to eliminate residual magnetism. The value of R on our application was 10,000 ohms.

A J FISTER *St. Louis, Mo.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

Check-Off List for Maintenance Supervisor

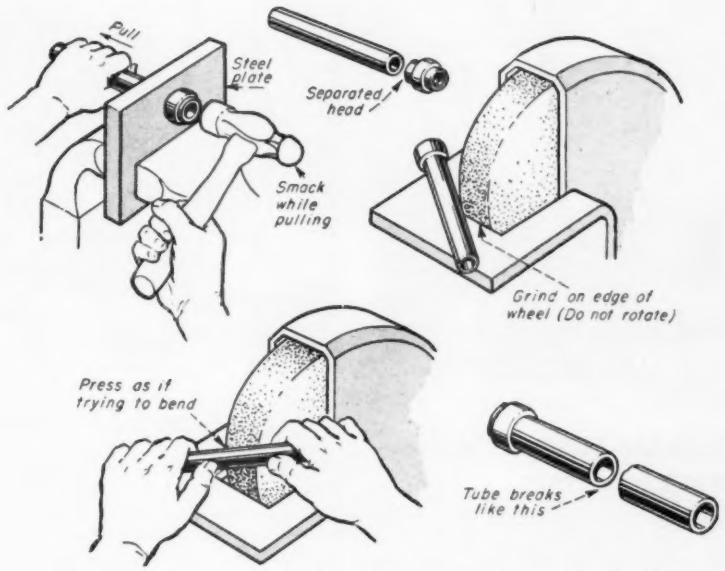
1. Do I have a written record of all equipment in my plant, with complete information for ordering spare parts for each unit?
2. What essential parts are needed to keep plant running?
3. Are there interchangeable parts in plant?
4. Do I have all parts on hand needed for all my equipment?
5. Do I have records showing when equipment was overhauled, conditions found, and repairs made?
6. Does operating crew take care of equipment properly while operating?
7. Are right lubricants used, and are they being used as directed?
8. Do I have an organized maintenance procedure for my equipment, or do I wait for breakdowns?
9. Do overhaul jobs take too long?
10. If they do, why so?
11. Do I, or does someone else, do any planning before a job is started?
12. Do I always have the material or parts on the job? Or is the equipment shut down and needed parts ordered later, thus delaying job?
13. Do I have, or can I always get enough experienced men to do a job as quickly, efficiently and safely as possible?
14. Are my men always told beforehand what a job is about, when it's to be done, and hazards involved?
15. Are proper tools on hand for doing the job?
16. Do I have a regular storage place for all tools, and are they kept in good condition?
17. Are my men well supplied with safety equipment, and properly dressed?
18. Are all ladders and scaffolds in good condition?
19. Is each job properly supervised while it's being done?

D WHISENNAND *Houston, Texas*

Use Radio Tone Signals

WWV IS USED for time reference in checking system frequency. But in emergencies, when atmospheric conditions preclude receiving the government time signal, radio programs of CBS, NBC and MBS with their tone signals can be utilized. Audible tone signals the start of each network program promptly on half hour and hour.

L FITZPATRICK *Jefferson City, Mo.*



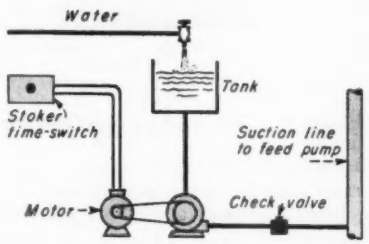
Breaking Porcelain Tubes to Right Size

JOBS OFTEN COME UP for hard-to-buy materials in plant maintenance. We ran into that in our experimental building. Some test equipment needed short coils of No. 21 nichrome wire, wound on 2x⅝-in. porcelain tubes. We needed about 100 such tubes. After much waste and lost time, we found by experiment how to break standard porcelain insulating tubes neatly into two pieces. Grasp tube in both hands, sketch. Press with both thumbs and pull with fingers, as shown in the above sketch.

Grind as if notching on edge of grinding wheel. Then tube will snap evenly. You break collar's head off neatly by inserting tube in drilled hole in plate. Just hit with sharp blow on head while pulling on tube.

There are many uses for short tubes, such as rheostat spacer, bushings, or for places where heat or insulation requires porcelain.

C H WILLEY *Penacook, N.H.*



Feeding Boiler Compound

WE HAD THE PROBLEM of putting compound into our feedwater, around the clock, without making a steady chore of it. Here's our solution.

First, we cut end out of a 30-gallon barrel and fastened it to wall near feedwater pump. Then we piped a ½-in. water line with globe valve to top of barrel, sketch. This is fill line for barrel after desired amount of compound is put in to last 24 hours.

From barrel's bottom, another ½-in. pipe is connected to an old truck water-circulating pump, driven by ¼-hp motor. Motor is controlled by the stoker-feed time switch. Switch is set to run ½ to 1 minute every half hour. Outlet from pump is to suction line of boiler feed pump. There is also a check valve in ½-in. line from pump to feed-pump discharge.

A L THILOUIST *Montgomery, Minn.*

(*Continued on page* 130)

More PRACTICAL IDEAS

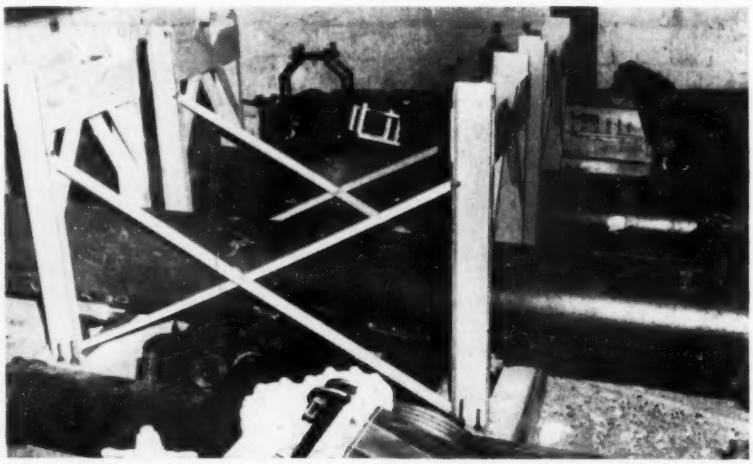
Begins on page 128

Portable Platform Helps Wash Insulators

PACIFIC GAS & ELECTRIC Co had problem of removing dust and debris from city power-pole insulators before start of rainy season. To do a fast, thorough job, the company bought a telescopic ram from a tree firm. Ram has a small platform; rig is set on a tank truck, which carries 2000 gallons of water.

Now, with a hose and 60-psi pump, a workman rides the rig along the streets, raises and lowers himself at will, and squirts the insulators clean by a jet of water from a hand-held nozzle. Water is tested to be sure its e'ectrical resistance is high enough to prevent danger to hoseman up on platform.

G F BURNLEY *Oakland, Calif.*

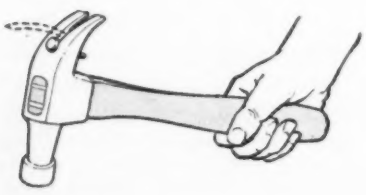


Condenser Stands Must Be Rigid

IT'S NO USE doing a first-class job of hooking up heat exchangers, condensers and receivers if they are not supported on a solid stand. Photo shows welded channel iron stand, with cross pieces, bolted to concrete foundation.

I've found these stands to be as light yet as durable as any for air-conditioning equipment. A good welder can cut out channels, flat iron and angle iron cross pieces in a hurry. Cross pieces need not be heavy, yet they hold vertical parts rigid. Then piping connections won't leak, because of sagging condensers, or what have you.

MIKE BRANNIGAN *Kansas City, Mo.*

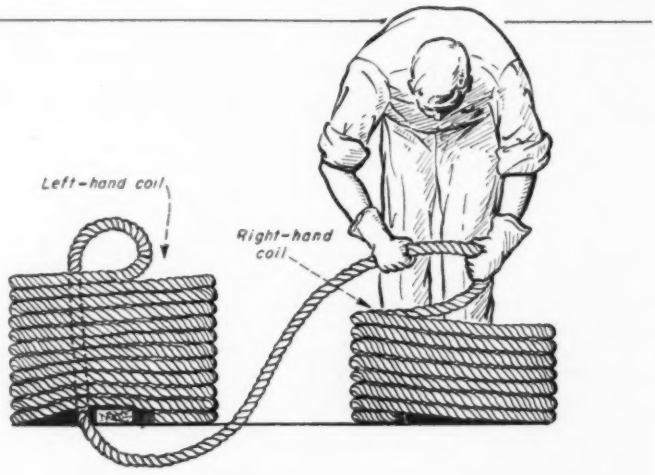


Nail-Pulling Kink

IN PULLING NAILS, work is often slowed down because they wedge into claw slot. Then you have to remove each nail from claw by hand.

Simple way to prevent wedging is to jam one nail into place "upside down," sketch. Snip off point. You can then pull nails without any hitch. If right-sized nail is wedged, the next nail being pulled falls out of claw by itself.

S V WORTH *New York, N. Y.*



Handy Trick Unkinks Rope

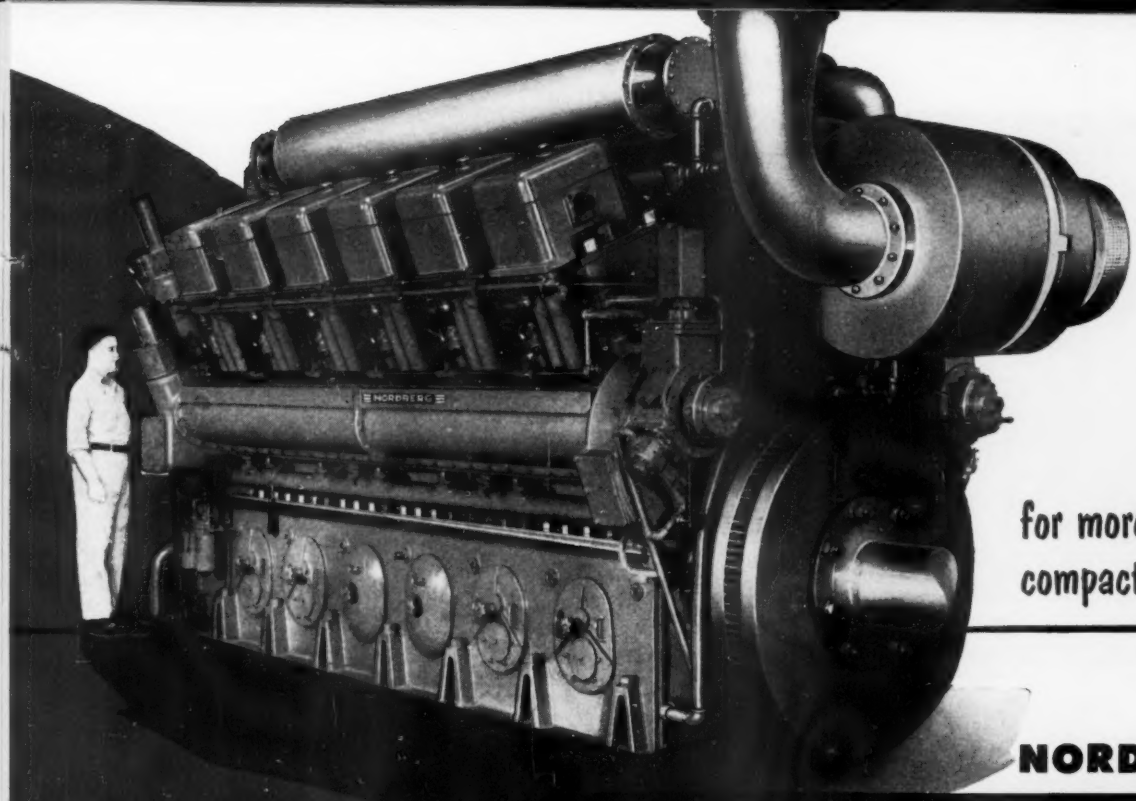
HERE'S ONE WAY to get kinks out of new rope when preparing a batch for service. It has these advantages: (1) It's done quickly in a small space. (2) Rope is unharmed, dry, and ready for immediate storage or service.

When novices try this job without being shown how it's done, they usually snarl rope badly.

I have seen 1200 ft of new rope towed behind a boat in water until kinks came out. But that's a rough way to treat good line. Some hang rope out a high window by the bight till the rope decides to behave. That takes a high building to treat a bale at a time, as rope is shipped in 1200-ft bales. Method shown is one I learned from a saltwater sailor. I have since used it many times with success. It's the handiest I know.

H B MCDERMID *Long Beach, Calif.*

(*Continued on page* 132)



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FOUR-CYCLE V-TYPE ENGINES

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- HIGH THERMAL EFFICIENCY
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- DEPENDABLE
- RUGGED CONSTRUCTION
- WIDE HORSEPOWER AND SPEED RANGE

. . . another important Nordberg advancement in the design and development of more efficient engines

Here is the Nordberg four-cycle SUPAIRTHERMAL V-Type engine . . . designed and built for continuous low cost operation for a wide range of stationary and marine power applications. This engine is available in 12 or 16 cylinders of 13″ bore in Diesel, Duafuel or Spark-Fired Gas types from 2400 to 4260 hp at 450 to 600 rpm.

The design of this V-Type engine incorporates all tested and proved performance features of Nordberg 13″ bore in-line SUPAIRTHERMAL engines. The high thermal efficiency of the SUPAIRTHERMAL engine is made possible by variable inlet valve timing control . . *an exclusive patented Nordberg feature.*

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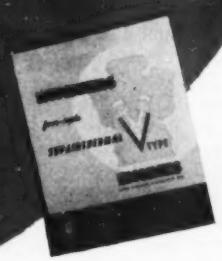

For full details write for BULLETIN 197.

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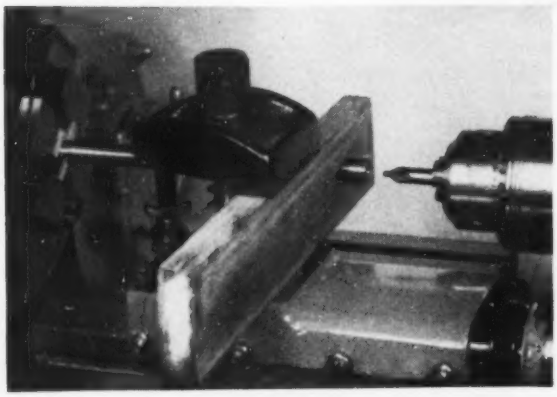
More PRACTICAL IDEAS

Begins on page 128



Lathe's Steady Rest Is Easy to Make

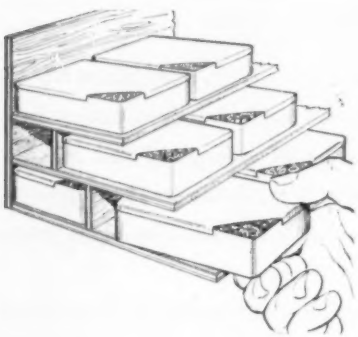
WHEN DOING LATHE WORK, setting up the 3-point steady rest for placing a center hole in end of a small-diameter shaft can take longer than actual center drilling.

I cut time by using a hardwood strip, clamped in tool post, photo. Drill holes of varying diameter for different jobs to be done.

Drill holes for work by placing drill chuck in headstock and feeding hardwood strip to rotating drill. If wood is drilled with same side down on compound rest, any work mounted in one of the holes is right height at center. After truing up a shaft in chuck, place wood over hole it fits into, and clamp down.

This "steady rest" can be mounted in place in a few seconds. Having work run true in chuck is not too important as steady rest bears on works outside. That insures hole being in exact center.

C T BOWER *London, England*

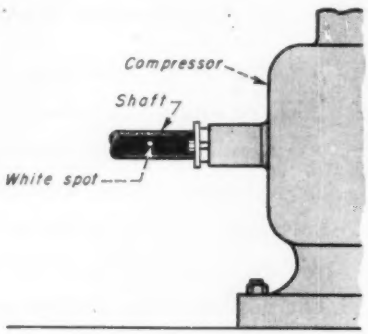


Small-Parts Container

HERE'S a small-parts container rack I made from small Edgeworth tobacco tins. As sketch shows, you get a quick view of contents at all times. Just cut each cover diagonally across corner as shown. Round sharp edges to prevent cutting fingers.

Take box out of rack and shake a few pieces into your hand, still retaining cover effect against spillage. Also, boxes can be stacked without a rack when taken to job at bench.

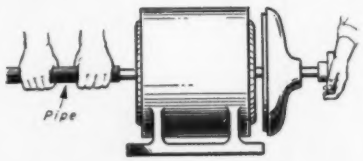
C H WILLEY *Penacook, N. H.*



Dot Shows Speed

OUR AMMONIA COMPRESSOR for freezing ice is driven by a wound-rotor slipring motor. Speed is regulated with a rheostat. But compressor speed must be adjusted at times to suit ammonia-suction-pressure variations, caused by degree of freezing ice. We painted a white dot on exposed surface of compressor drive shaft, sketch. This helps know compressor's speed by looking at it. Slower speed of shaft is easier to judge than much faster rim speed of flywheel.

T TRAIL *Catonsville, Md.*



Pipe Prevents Damage

RAN INTO IT again the other day. Squirrel-cage motor windings, 100 hp, 440 v, showed zero resistance, windings to ground. On opening her up, we saw motor had been overhauled recently. It was very clean, with new varnish still gleaming.

Close look at core at laminations' edge near motor's bottom showed some had been curled over. (We know we didn't do it because the new insulating varnish had been put on afterward.) Tests later proved these laminations had curled over enough to puncture insulation and cause dead ground. This is usual example of saving expensive shutdowns and repairs with a little care in handling rotor.

Here's the way I handle these rotors. After removing one end, I free other, ready for removal. Place pipe over the shaft, sketch. This allows one man on each end of shaft and rotor to guide stator through safely.

Keep several lengths of various-size pipe handy if you have several motors. Paint bright stripes on pipe so they won't get thrown in scrap-pipe pile. These pipes prevent damage, and save fingers, too, besides saving windings.

E ECKERT *New York, N. Y.*

Metalized Cooling-Tower Doors Don't Corrode

OUR LARGE, FORCED-DRAFT spray-tower was built in 1938. Makeup water is very high in sodium chloride, especially after three or four concentrations. We tried all kinds of paint, but none lasted over 40 days. In 1945 we replaced steel doors at $57.50 each.

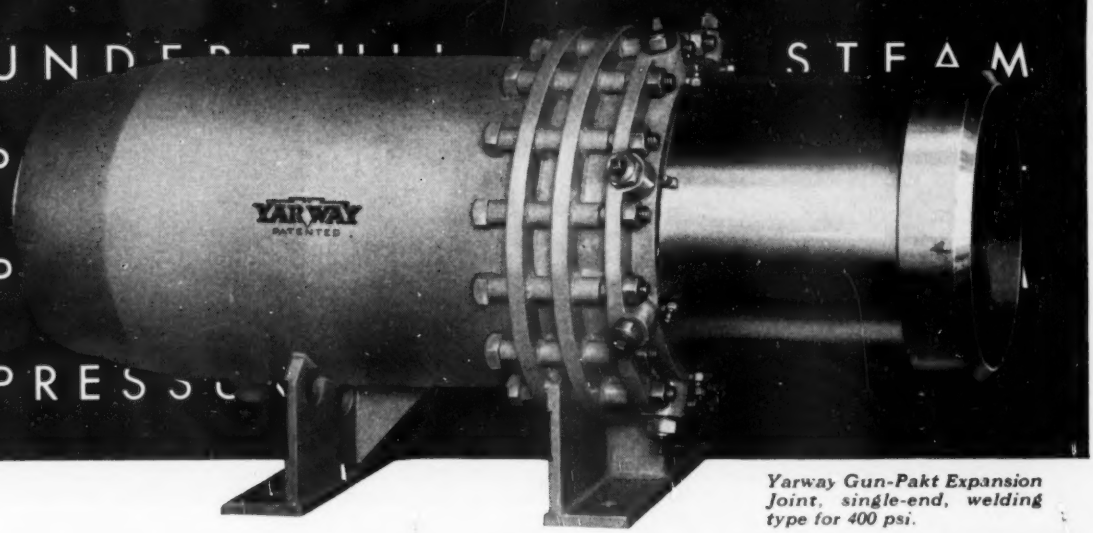
We sandblasted new doors, then sprayed on lead 0.010 in. thick. The four doors have shown no corrosion since that time.

Cost of metalizing both sides of these doors was only $27.50 per door, or 15c per square foot. While sandblasting and metalizing, be sure to protect operators against dust, lead spray and fumes.

Of course cost of metalizing equipment must be added to this, but you can write that off by doing other jobs with it. And other jobs do come up.

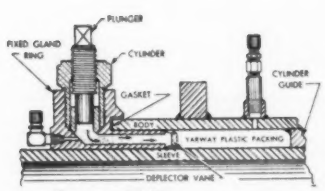
I. HANSEN *Lawton, Okla.*

GUN-PACKED UNDER FULL STEAM PRESSURE • GUN-PACKED UNDER FULL STEAM PRESSURE • GUN-PACKED UNDER FULL STEAM PRESSURE



Yarway Gun-Pakt Expansion Joint, single-end, welding type for 400 psi.

BEHIND IT...AN ENGINEERING REASON



Cross-section of Gun-Pakt feature.

More large central station heating plants are using Yarway Gun-Pakt Expansion Joints in their steam distribution lines than any other type. This popularity of Yarway Gun-Pakt Expansion Joints in public utilities, institutions and industrial plants is due to the engineering reason behind them . . . *they are packed by a gun under full steam pressure.*

No shutdowns of steam lines, no production delays . . . you just insert a plug of Yarway plastic packing, twist a wrench, and the joint is tight, the job is done.

Such labor saving features, combined with impressive records of low maintenance requirements, make Yarway Gun-Pakt Joints a natural selection for your steam lines. Certainly you'll find them worth investigating.

Write for Yarway Expansion Joint Bulletin EJ-1912.

YARNALL-WARING COMPANY
100 Mermaid Avenue • Philadelphia 18, Pa.

YARWAY | *gun-pakt expansion joints*

PLANT PROBLEMS... *put your know-how to work*

Question No. 1: Why Is Diesel Piston Worn?

HERE ARE THE FACTS: One piston of our 4-cycle 8-cyl 1000-hp diesel is worn oval about 0.015 in. on the thrust side, and the rings are worn the same way. Liner shows normal wear with no scoring.

Recently we put in a new piston and ran for three hours. Then the wrist pin got hot and the piston scored the liner.

Checking the engine we found outside lubricator supplying oil to pistons was working right when scoring occurred. We now get a noise from this cylinder that sounds like a piston slap. Since engine is only 11 months old and all pistons are correct size, what is causing our trouble?

Why did piston wear oval in such a short time? What's best way to repair piston and liner? How can we avoid trouble in this engine?—*BB, March Power*

Here Are the Answers

THESE PHOTOS show piston scoring from abnormal thrust, caused by engine overload, and fatigued crown resulting from continued overload.

An unbalanced and overloaded cylinder leads to abnormal thrust pressure on piston. This may overload wrist pin and bushing, or distort connecting rod. More heat must be rejected to cooling water when engine is overloaded. Higher heat load may break down oil film. Lack of good lubrication can lead to seizure and scoring.

Good corrections include: (1) Hone or rebore liner. If maximum bore limitations are exceeded, renew liner. (2) Clean the piston; renew if under minimum diameter or if distorted. Remember, using a liner with maximum bore and a piston with minimum diameter may produce too large a clearance.

(3) Check rod alignment and straighten or renew if necessary. (4) Refit or renew wrist and pin bushing. (5) Renew piston rings. (6) Check connecting rod bearings, adjusting as needed. (7) Clean cylinder cooling-water passages. (8) Reassemble engine and take cold compression readings on cylinders.

(9) Run engine at no load, checking compression and exhaust. (10) Reset fuel racks. Run engine under load while adjusting fuel system to give equal exhaust temperatures in each cylinder.

Excessive skirt clearance causes piston slap, but a similar sound may come from too early injection of fuel. To isolate and eliminate fuel noise, shut off supply to cylinder in question while engine is running. If noise stops, retime fuel pump.

CARL J SARNE *Havertown, Pa.*

CRANKSHAFT BEARINGS aren't at fault because *BB* reports no trouble with them. Wrist pin is at fault. Its clearance may be less than manufacturer recommends. This will cause overheating.

Rebore liner and fit an oversize piston. Same wrist pin may be used, but check to see that pin ends fit piston and bearings with right clearances.

A J BREUGELMANS
New York, N. Y.

CHECK CRANKSHAFT alignment. We had similar trouble in a 5-cylinder engine. There was 0.005-in. distortion at No. 4 crank. Piston and rings in this cylinder wore as *BB* describes. Refitting the main bearings and lowering outboard bearing stopped wear in No. 4, but then it showed up in No. 5.

BB's trouble is from misalignment. Best cure is to align engine as carefully as possible. Repair a worn cylinder by reboring to a larger size and fitting an oversize piston. Or build up liner surface with porous chrome to standard size, and use a new piston.

A M DAMEROW *Elk River, Minn.*

CONNECTING-ROD bearing is fitted too low on one side. This pulls rod foot down, causing excessive side thrust on piston. Insert a shim of right thickness to align rod foot correctly. Check clearance of the bearing after fitting shim.

F A BUTLER *Dallas, Texas*

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*

ALWAYS CHECK piston for roundness after driving in a wrist pin. When a piston is out of round it wears more rapidly. A few hearty whacks with a lead hammer usually cures this trouble in our plant.

If wrist-pin clearance and connecting-rod side play are normal, pin heating results from lack of lubrication. Check oil bore in rod, holes in wrist pin and crankbox. You may find a rag or some lint in crankbox oil hole.

J F TILLIER *Mexico City, Mex.*

MISALIGNMENT between piston and liner is causing *BB's* trouble, not faulty lubrication. Oval wear of piston thrust side shows that misalignment is the culprit. Check liner for wear in fore and aft direction of engine.

Scoring shortly after new piston was installed could not be blamed on the piston if its dimensions were correct and liner was in good condition.

Check piston-pin clearance to see it agrees with manufacturer's recommendation. It should be free of score marks. Also, check rod for straightness. If liner isn't worn excessively, you can be certain connecting rod and its bearings are at right angles with crankshaft. Consult engine manufacturer for best repair methods when you expect to do a large job on your diesel engine.

HENRY GREINER *Anoka, Minn.*

LARGE LINER BORE and small piston allow piston to wobble in cylinder. Small bore with a large piston causes overheating, scoring and possible seizing. Piston that has too much clearance wears oval, and causes liner to wear oval in a shorter time than normally expected.

When fitting rings to out-of-round cylinders, be sure they are fitted to the largest diameter of cylinder to prevent ring binding, distortion, overheating, etc.

Renew the liner, instead of reboring it. Fit new piston.

JOHN GEIST *Brooklyn, N. Y.*

HOT WRIST PIN suggests it may be fitted too tightly. This could cause unequal wear in cylinder. Be sure wrist-pin ends fit piston and bearing properly. Wrongly fitted wrist pin can run hot, seize, and force piston sides out against liner, scoring it. Check pin carefully.

PETE TELLER *Chicago, Ill.*

SLIGHTLY BENT connecting rod causes this trouble. Bent rod throws an unbalanced load on wrist-pin bearing; oil distribution is poor. Rod causes piston to slap cylinder wall on dead center.

A heavy fuel charge in this cylinder during cold starting might cause connecting rod to bend, especially if start is sudden and engine has a large flywheel. Cylinder relief valves, if fitted to engine, should pop when fuel charge is excessive.

Since a good job is important I'd call in the manufacturer's engineer to get the best advice possible.

ART BELTON *Montreal, Can.*

Question No. 2: Is This Stack the Right Size?

HERE ARE THE FACTS: The steel stack for our new boiler is to be 50 in. dia, 150 ft high above boiler-room floor. Boiler is rated at 20,000 lb per hr, 125 psig, 353 F. Feed temperature is 212 F, gas leaves boiler at 585 F. There is no heat recovery. CO_2 leaving furnace is 14%, leaving boiler 13.5%.

Losses expected are: dry gas 12.5%, H_2 and moisture in pulverized-coal fuel 4.8, moisture in air 0.30, unburned combustible 1.5, radiation 1.2, unaccounted for 1.5%.

Guaranteed boiler efficiency is 78.4%; average draft loss through boiler is 0.60 in. H_2O; required draft at entrance to first pass 0.15 in. H_2O; furnace draft needed at minimum rating 0.05 in. H_2O.

Proximate fuel analysis is: moisture 2.88%, volatile 36.0, carbon 52.36, ash 8.76%.

I don't think stack size recommended is right. What's best way to check stack size? Is size recommended correct?—*GK, March Power*

Here Are the Answers

STACK HEIGHT, DIAMETER depend on (1) amount of fuel to be burned (2) fuel type (3) gas temperature (4) type grate (5) design of boiler and breeching (6) flue arrangement (7) plant altitude, and (8) atmospheric air temp.

Amount of fuel that will be burned determines flue-gas quantity. Gas temperature and plant altitude fix gas volume. You must know these factors to find stack diameter.

Amount of fuel and its properties, together with grate type and boiler design (number of passes, turns, etc) determine draft intensity required. Gas and atmospheric air temperatures are needed to find thermal head available.

Though *GK's* data are incomplete, I've computed stack size, using several reasonable assumptions. I'm assuming boiler is stoker fired because pulverized fuel is generally not considered economical for outputs of less than 50,000 lb of steam per hr. Also, with pulverized-fuel firing, air heaters generally supply hot air for heating and transporting the fuel. *GK* mentions no heat recovery, another reason for assuming stoker firing.

From the proximate analysis, computations show his fuel has a heating value of 14,910 Btu per lb on a moisture-and-ash-free basis. On the original basis it is 13,100 Btu per lb.

Boiler Heat Balance

	%	*Btu/lb fuel*
Input	100	13,100
Output	78.4	10,250
Energy losses:		
Dry flue gas	12.5	1635
H_2 and H_2O in fuel	4.8	628
H_2O in air	0.3	39
Unburned combustible	1.5	195
Radiation	1.2	157
Unaccounted	1.5	196

Boiler heat balance is in table, left.

At an output of 20,000 lb of steam per hr, quantity of fuel burned when boiler runs at guaranteed efficiency of 78.4% is 1970 lb per hr. Theoretical amount of air needed for firing this fuel with a heating value of 13,100 Btu per lb, is found by calculation to be 10 lb of air per lb of fuel. Therefore, total amount of air theoretically needed is 19,700 lb per hr.

From the dry gas loss expected, 12.5%, we can compute weight of dry gas per lb of fuel as 13.5 lb. Total dry flue gas from combustion is (1970) (13.5) = 26,600 lb per hr. Using the dry flue gas quantity and theoretical air for combustion, excess air is 35%.

Dry gas leaving boiler includes all

More PLANT PROBLEMS

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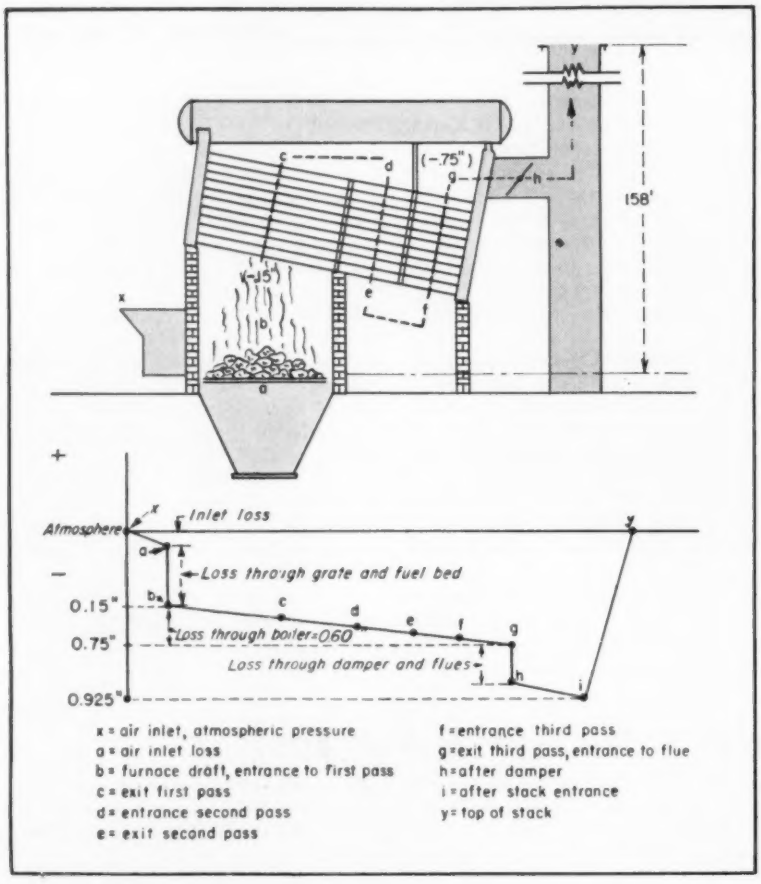


carbon actually burned, nitrogen in fuel, sulfur, excess oxygen from air, oxygen used to burn the carbon and sulfur, oxygen supplied with fuel and nitrogen in air supply. It does not include oxygen used to burn hydrogen in the fuel.

To accurately compute all these quantities, ultimate fuel analysis must be known. However, charts in *Combustion Engineering*, published by Combustion Engineering, Inc, permit determination of a number of these values. Chart values may be used to check air requirements for the job.

From the charts, total combustion products are found to weigh 27,800 lb. This is the quantity of gas the stack must discharge to the atmosphere.

Temperature of gas leaving boiler is given as 585 F, but this is reduced somewhat, depending on breeching length and air leakage into ducts and stack. So an average temperature might be more appropriate. This can be computed by an empirical relation, and works out to be 535 F.

Chimney height can be computed once we know average gas temperature, outside air temperature and total draft loss through grate, boiler and flues. Sketches show probable relation between boiler installation and draft at various points.

Based on flue gas of average density and a flow rate of 27,800 lb per hr, stack capacity must be 193 cu ft per sec. Using charts and curves in *Combustion Engineering*, we find an economic diameter and velocity for this capacity is about 3-ft, 10-in. diameter, 14 ft per sec velocity. At this velocity, acceleration loss in stack is about 0.027-in. H_2O with a friction loss of about 0.0003-in. H_2O per foot of height for an unlined steel stack.

Draft required at boiler outlet is 0.75 in., plus loss for one or more 90-deg bends in uptake, loss at damper, friction in flue and acceleration loss. Loss at bends, damper and in acceleration will be 0.13 in. Stack friction loss will be about 0.045 in. Total draft loss is sum, or 0.925 in. H_2O. Required stack height at sea level is 143 ft.

If *GK's* plant is at sea level, stack height recommended to him is probably sufficient if atmospheric pressure does not vary appreciably. However, in many parts of the U. S. the barometer may vary as much as 3 in. Hg. This is equivalent to an altitude variation of over 2500 ft. If this 3-in. variation were to be included in the design, required stack height would be about 158 ft.

I recommend that *GK* use a stack 158 ft high above fuel bed. Diameter should be at least 3 ft, 10 in.

E E Moss *New York, N. Y.*

EDITOR'S NOTE: *Below are answers of other readers whose calculations agree substantially with those of Reader Moss. Instead of repeating their arithmetic we are including their conclusions only because they give enough info.*

STACK IS LARGE ENOUGH for a boiler rating of 20,000 lb per hr. In fact, with a stack of this size, about 19% more gas can be handled when load rises. This statement assumes that boiler damper is wide open. My calculations are based on charts I've constructed, using well-known empirical equations.

C J BURY *Salt Lake City, Utah*

CALCULATIONS show required stack area is 13.6 sq ft. *GK's* proposed stack is large enough for the job. Economic velocity for his conditions is 13.8 ft per sec.

I believe he would be wise to install a forced-draft fan to obtain more thorough mixing in the furnace. Stack discharge would be higher, reducing the smoke nuisance in his plant area.

A J BREUGELMANS *New York, N. Y.*

FOR STEAM OUTPUTS of 20,000 lb per hr, stack is right size, according to my calculations. If output is greater, stack size may not be right.

H B WAYNE *Brooklyn, N. Y.*

SMALLER-DIAMETER stack can be used, but it should not be less than 48 in. Height of 150 ft is just about right.

ALBERT MOULTON *Pittsfield, Mass.*

STACK SIZE, as specified, is correct. Diameter is right, too.

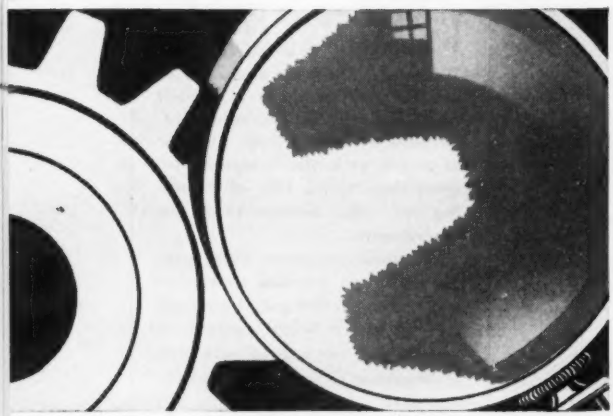
ROBERT M BOND
CURTIS L MARTIN
Orangeburg, S. C.

EVIDENTLY *GK* has run boilers fitted with induced-draft fans. These do not need so large a stack. But my calculations show that for his conditions the stack is well proportioned.

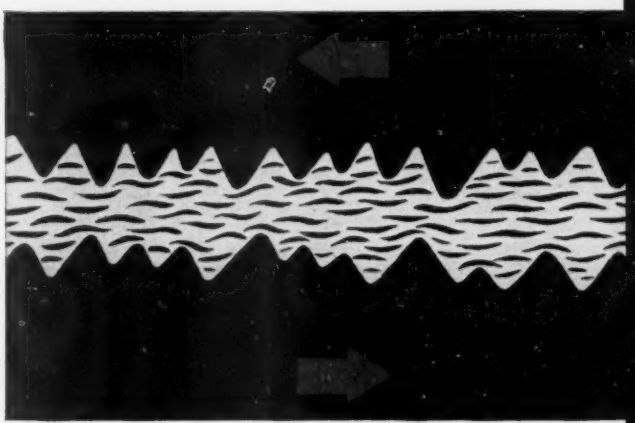
KURT TRAUB *Detroit, Mich.*

(*Continued on page* 138)

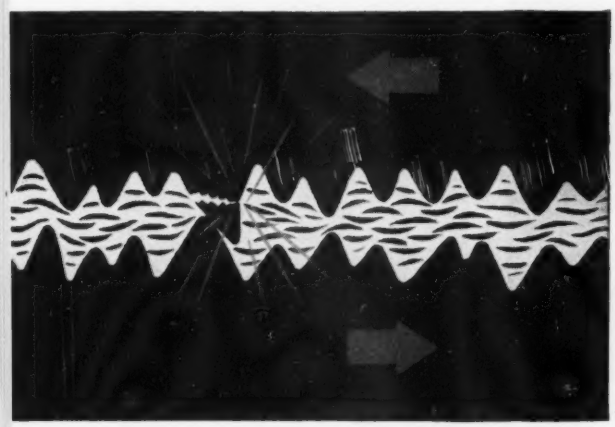
HOW SUNEP PREVENTS GEAR WEAR



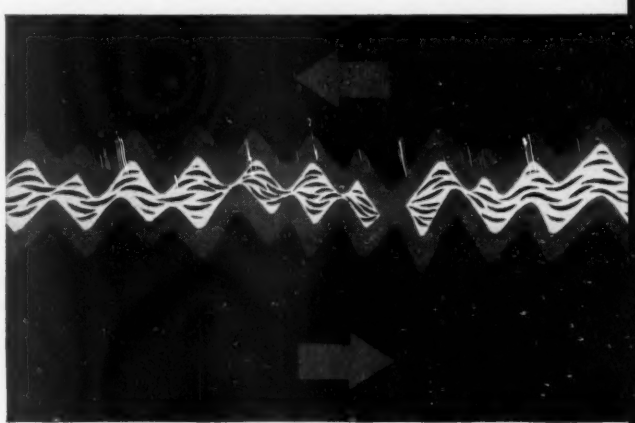
The surface of a gear may seem smooth, but when greatly magnified it looks something like this. The lubricant must keep these jagged edges apart.



With ordinary oil, a thick film is needed to keep these metal surfaces apart. The thickness of the film depends on the viscosity of the oil and other factors.



It is difficult to maintain a thick oil-film in everyday practice. The oil film thins out and semiboundary lubrication results. With ordinary oil, metal to metal contact occurs and gears wear.



Sunep coats the surfaces with a chemically bonded film which is virtually unbreakable. This film, although only about 0.0000001" thick, keeps the surfaces apart, withstands heavy loads and sudden shocks, prevents wear.

Sunep has many advantages. In addition to its outstanding load-carrying ability, it is noncorrosive; it keeps gears and bearings clean; it prevents rusting; it stays put. And its additives do not drop out during use or after prolonged storage. For more information about Sunep and how it protects your equipment, call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. P-6.

INDUSTRIAL PRODUCTS DEPARTMENT

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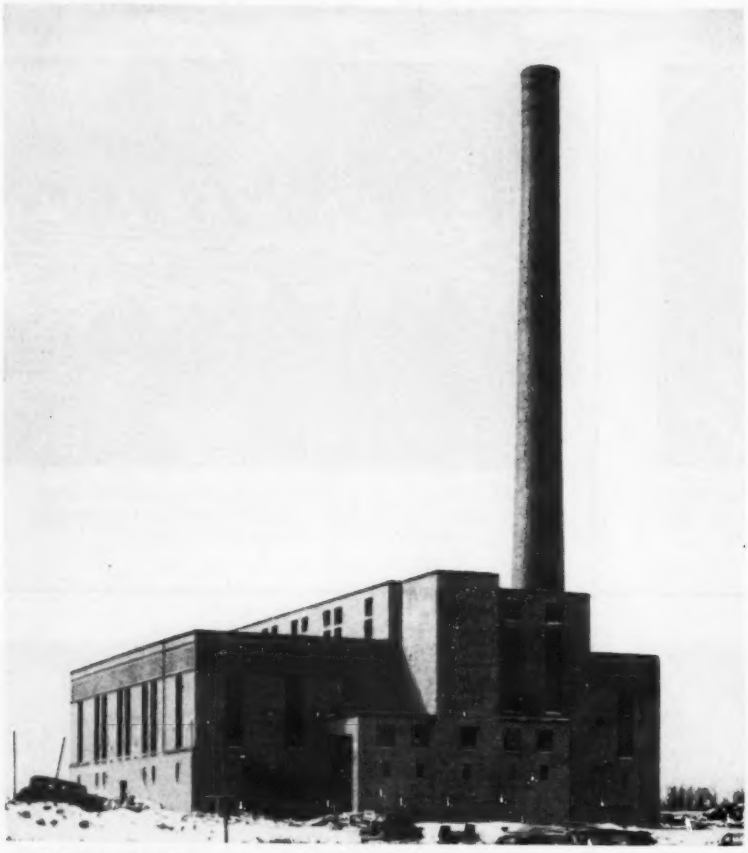
More PLANT PROBLEMS

Begins on page 134



FOR GOOD RESULTS, both brick and steel stacks must be carefully designed, built

NEW BREECHINGS were recently installed in our twin, 150-ft stacks. During construction we decided out of curiosity to check stack size. Of course, there wasn't too much we could do if calculations showed size was wrong, but we went ahead anyway. Here are some things we learned.

Many stack types and sizes may do the job. Cost and economy may be the deciding factor in the long run. Stack type, its height and diameter are important factors in cost and capacity. Stack must be high enough to prevent soot and smoke from becoming objectionable to the neighborhood.

EDWARD DELNICK *Brooklyn, N. Y.*

STACK IS OK for rated output of 20,000 lb per hr, but may be a trifle undersized for greater outputs.

JOHN B THUMAN *Buffalo, N. Y.*
E J ANDERSON *Cleveland, Ohio*
MAX SHERRITT *Huntington, W. Va.*

EDITOR'S NOTE: *Some readers disagree with Reader Moss and the other contributors. Here are their comments.*

SIZE IS WRONG. It should be: height 155 ft, diameter 40 in.

E MOLINA CORDERO
Buenos Aires, Argentina

HEIGHT is too great. With a 50-in.-diameter stack on this job, its height need be only about 120 ft above the boiler-room floor. This will give enough draft to run at full load with a wide-open control damper.

F M BRUNN *W. Englewood, N. J.*

MINIMUM DIAMETER should be 39½ in. with a height of 250 ft to meet draft requirements on this job. Draft with stack proportions proposed by *GK* is only 0.90 in., while calculated draft is 1.25 in., according to my figures.

P J GARBER *Forest Hills, N. Y.*

YOUR NEW PROBLEMS

1 What's Best Way to Remove Ammonia?

We have 2000 lb of ammonia in our refrigerating system, which serves a large cold-storage plant. Because we have a large number of employes in the basements we need some quick way of disposing of this ammonia in an emergency.

We have adequate water supply from an outside source as well as a 50,000-gal, basement storage tank. What method, if any, could we use to mix this ammonia with water in the storage tank, or mix it and then discharge it to waste? We'd like to be able to get rid of the ammonia in about 10 minutes.

Can *Power* readers suggest some rapid mixing method, permitting safe disposal of our ammonia?—*TS*

2 What Causes These Burn Spots on Bars?

The commutator on a 25-hp 6-pole 70-rpm dc shunt-wound elevator motor has six equally distributed burn spots corresponding to the brush spacing. Each burn covers an area of four commutator bars, and begins to appear a few days after resurfacing the commutator.

We have had this trouble since we replaced a few coils several years ago. Believing the cause might be in the coils, I checked them repeatedly without finding any trouble.

When elevator ascends no sparks occur, but slight sparking appears when it descends. There is somewhat more sparking during starting and stopping.

We have several other machines in service and though they spark there are no burned areas on their commutators. What causes this trouble? How can we cure it?—*VN*

Don't miss next month's problems. Another chance to use your ingenuity

Will you help readers who sent us problems? Extra pay for photos or sketches.

HOW TO

Burn Foundation Holes

Now you can pierce rock, concrete, stone, granite, asbestos and other refractory with electric arc and welding machine of 400 amp. up. Flame of 5 to 8 in. is over 8000 F. Double pole electrode and holder make grounding unnecessary. Piercing speed: 1 to 3 in. per min; it depends on material.

1 Set the welding machine of any conventional design to 400 amp or over. This depends on the material to be pierced

Courtesy, Eutectic Welding Alloys Corp

2 Insert rod in special holder. Rod is 18 to 20 in. long — may be longer

3 Place end of rod on concrete to be pierced for bolts, turn on current

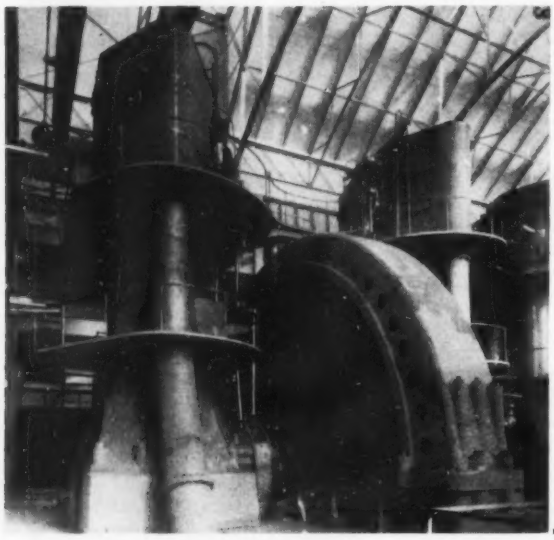
4 With the current on, push steadily through the concrete to needed depth

5 Move rod in and out of hole while burning. For hole larger than rod diameter, use a slow, spiral downward motion

6 Place the anchors in holes, move machine, and screw down bolts into the anchors. This job was done in few minutes

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers



How Can We Save These Engines?

A NUMBER of 10,000-hp reciprocating steam engines still exist at 59th St Power Plant, New York City Transit System. In a few years these giants will probably be scrapped.

The engines were the last and largest ever built for power-plant use so they have considerable historic interest. Perhaps some museum will be able to preserve at least some of the parts like a low-pressure piston, piston rod, connecting rod and crosshead. Preserving a complete engine would be even better, but it would be a tremendous undertaking.

Another possibility is for some museum to make a model of the engines like models of marine steam engines in some nautical museums.

About two years ago I asked a number of museums about preserving parts of the similar engines that were being removed from the 74th St Power Plant. But for various reasons, no museum was able to take any action.

Has any power engineer with interest in historical values a suggestion on how to preserve these machines?

H B REYNOLDS *New York, N. Y.*

When Do I Open a Quick-Opening Valve? Here's a Difference of Opinion

"First," declare these nine readers, and . . .

REGARDING QUESTION in March Arguments, "Which Blowoff Valve Should Be Opened First?" I submit the following observations:

Quick-opening valve nearest boiler, should be opened first, closed last. This valve does the sealing. By opening it first, seat and disk are protected from wear and scoring, as operation is in a balanced fluid pressure. In addition, opening slow-opening valve last precludes pressure-change shocks to blow-off piping. Outer valve sustains virtually all operating wear of wiredrawing and abrasion from sludge and scale blown out of boiler.

A W GOULD *Lowell, Mass.*

CHECK ASME CODE. "Care of Power Boilers," section VII, par C-28, reads "When a boiler is equipped with both blowoff valve and cock or quick-opening valve in same blowoff connection, always open cock or quick-opening valve first, blowoff valve second. Close blowoff valve first, quick-opening valve second.

Most engineers prefer to have quick-opening valve next to boiler. Regardless of location, open or close sealing valve when there is no flow.

H S BRUNSON *St. Paul, Minn.*

WHEN BLOWING DOWN boilers, I emphatically disagree with those who advise opening outer valve first, closing it last. They claim this puts most wear on inner valve. They are so right—that's why I disagree. I much prefer having valve nearest boiler in good condition for safe operation.

ART CANNON *Laurence Harbor, N. J.*

TO ELIMINATE possible dangerous water hammer when a quick-opening valve is violently jerked open, always open slow valve second. If you like to live, avoid sudden rush of hot water down a line that often contains sharp bends and sometimes cast-iron fittings.

Years ago many operators believed sudden release of water through a quick-opening valve flushed the boiler better. Many portable-boiler operators still favor quick-opening valves exclusively, as such boilers are often plagued with deposits from poor-quality feed. Fortunately, these units rarely have long blowoff lines.

Where there are two valves they should be close together and quick-closing valve should be nearest to boiler.

E F FERNES *Baltimore, Md.*

These readers say "first," too:

J A MIDDLETON	*Calgary, Alta.*
G MILLBURN	*Stratford, Ont.*
E J ROSE	*Detroit, Mich.*
M F C PAWLIK	*Baltimore, Md.*
F J SETLAK	*Omaha, Neb.*

"Last," say these four

I SAY quick-opening valve should be opened last, closed first. There can be very little wiredrawing on blowoff valves. This method is safer for operator if line breaks.

R WILLIAMS *Vineland, N. J.*

SCREW-LIFT VALVE should be opened first to prevent wiredrawing valve and seat. Straight-through valve should then be opened cautiously. There is no object whatsoever in opening it quickly.

W G BEAVER *Copper Cliff, Ont.*

AS AN OLD NAVY MAN, let me quote a sound practice from Chapter 2, Article 543, *Bureau of Ships Manual:*

"To blow down a boiler when guarding valves are installed, it is first necessary to open the guarding valve and then the bottom blow valve." Article 545 adds, "Wherever bottom blow valves are used, open wide and . . . quickly."

C FOSSLER *Pasadena, Md.*

SHARP BLOWDOWN dislodges accumulated scale due to disruption of circulation in boiler or header. Open slow-opening valve first, then quickly open and shut quick-opening valve. Where water is heavy in solids, repeat quick blowoff in an hour. If piping is up to ASME specifications it can stand heavy load imposed by this practice.

J M GORRIE *Richmond, Va.*

WILL THIS ORGANIC AGENT ELIMINATE BOILER SCALE AND SLUDGE?

It might.

In water conditioning, the supplementary use of organic agents may well assure the difference between long, uninterrupted operation and frequent boiler outages due to scale and sludge formations.

But a word of warning! Not all organics are the same or equally effective.

Take, for example, the case of a large mid-western steel plant which had to acid-clean its 450 psi boilers at 8-12 month intervals.

Due to sharp variations in the raw polluted river water, the hardness and silica content of the lime soda effluent could not be maintained consistently as low as desired. Despite the use of phosphate-tannin treatment, boilers opened up in poor condition.

Betz Engineers studied the problem and recommended changing the type of organic. Results? Since this change, the boilers have not been acid-cleaned or turbined in three years.

What's more, the latest inspection report after 11 months' operation, showed that the only deposit found in the boilers was a handful of sludge.

If *your* plant is plagued by scale and sludge deposits, why not do something about it *now*, by calling in a Betz Engineer. He'll show you factual evidence how Betz *Specialized* Water Conditioning Service can help you solve *your* water problem. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

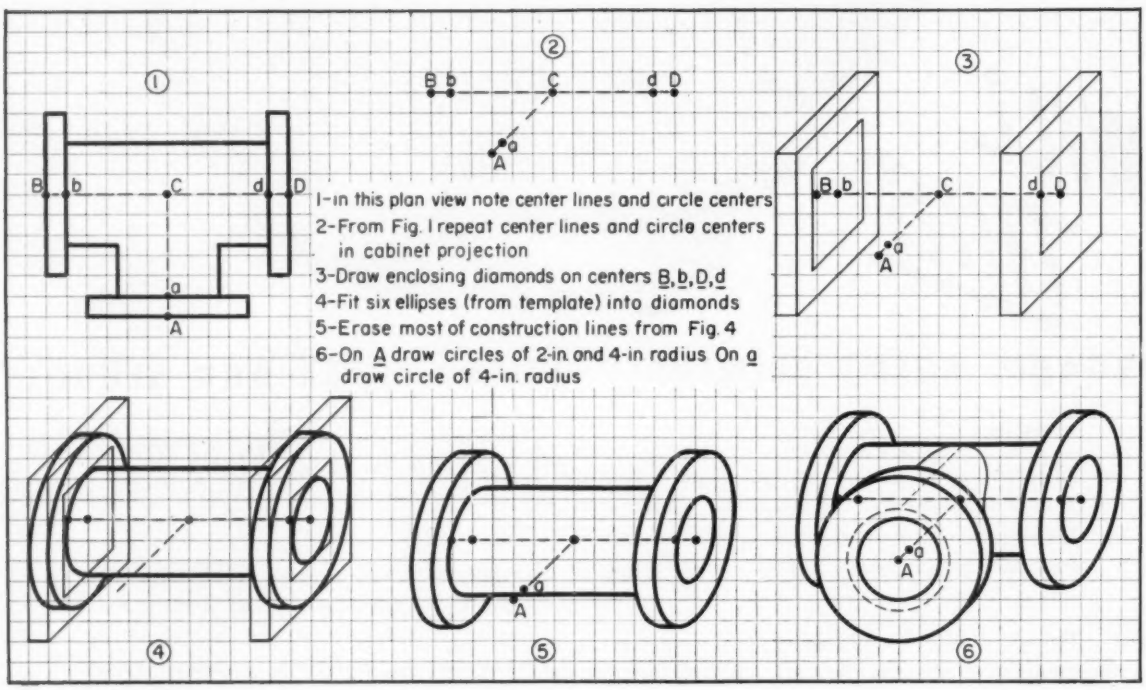
Write today for a copy of Betz Technical Paper No. 98, "Boiler Scale —Its Formation and Prevention."

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH


1-In this plan view note center lines and circle centers
2-From Fig. 1 repeat center lines and circle centers in cabinet projection
3-Draw enclosing diamonds on centers B,b,D,d
4-Fit six ellipses (from template) into diamonds
5-Erase most of construction lines from Fig. 4
6-On A draw circles of 2-in. and 4-in. radius On a draw circle of 4-in. radius

Easy Sketching System—10

► FIG. 1 is a plain top view of a flanged tee. No matter how you look at this tee in cabinet, either one or two flanges will be seen obliquely as ellipses. For the best-looking shot, let's select the side outlet for the facing view. Then the circles in this outlet will appear in their true shape. Don't draw these until the last; otherwise, they may confuse the more difficult construction for the ellipses.

In Fig. 1, note the center lines and *the points B, b, d, D,* and *A, a,* which serve as centers for the flanged edges. Fig. 2 repeats these center lines and these centers in cabinet projection to scale.

Next, imagine the flanges to be enclosed in square-cornered boxes, centering on the center lines that have been drawn in, and the indicated center points. Fig. 3 shows the sketch at this stage. The large diamonds are for the flanged edges. The small diamond at the right has the dimensions of the hole diameter. The small diamond at the left has the dimensions of the body diameter of the tee.

Next, Fig. 4, use template to find ellipses that will just fit into the diamonds. Trace them in as shown.

Fig. 5 is the same as Fig. 4, with construction lines erased, except center lines. Note that points *A* and *a* will be centers for the circles of facing flange.

In Fig. 6, use *A* as center for circles of 2-in. and 4-in. radius. Draw another 4-in. radius circle around *a.*

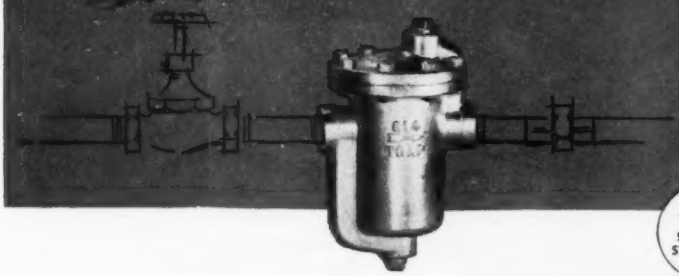
The dotted circle drawn outside the small circle represents the place where the body would penetrate the near face of the flange if extended. This circle sets the line of the body, most of which is hidden.

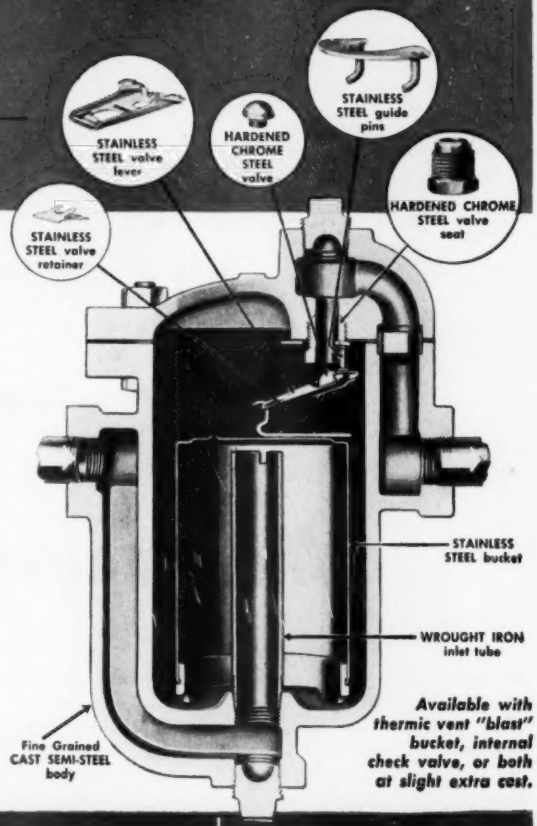
NOTE: *We suggest getting Dietzgen Truway ellipse templates from a drafting-supply store, or directly from Eugene Dietzgen Co, 218 E 23rd St, New York, N. Y. For a template of 20 ellipses, 1/8 in. long to 2 in. long, order No. 2275-25, price about $2.00. For 12 ellipses, 2 1/8 in. to 4 in. long, order 2275L-25, price about $3.50.*

NEW

ARMSTRONG No. 814

. . . a side inlet-side outlet steam trap with 1" or 1¼" pipe connections!




STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer
STAINLESS STEEL bucket
WROUGHT IRON inlet tube
Fine Grained CAST SEMI-STEEL body

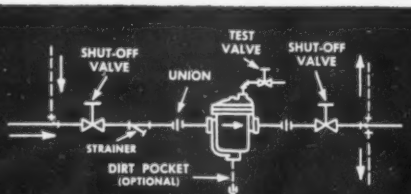
Available with thermic vent "blast" bucket, internal check valve, or both at slight extra cost.

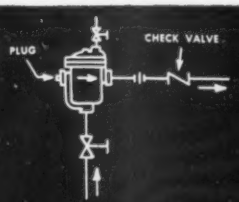
NOW, with the addition of the No. 814, you have a choice of five sizes of Armstrong side inlet-side outlet traps from ½" to 1¼" for use wherever horizontal and opposite pipe connections will make the simplest hookups. Bottom inlet-top outlet traps are available in the same size range, so that for the majority of all condensate loads you can use the body style that best suits the job.

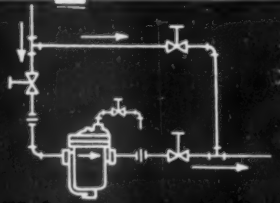
Capacity of the new No. 814 is 6500 lbs./hr. at 125 psig.; height 13⅝"; face to face dimension 8"; weight 45 lbs.; price $46.00 list.

For complete data on the No. 814 and other Armstrong traps, call your Armstrong Representative or mail the coupon today.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.







HOW TO ORDER:

Refer to Armstrong Catalog J, Sweets' Plant Engineering or Industrial Construction Files or Chemical Engineering Catalog. Capacities of the 814 are identical to the 214 trap listed in these Catalogs. Other data are given above. Specify trap number, pipe connections and maximum operating pressure.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

☐ Send complete data on No. 814 trap.
☐ Send Catalog J listing all Armstrong traps.
☐ Have Representative call.

Name_____

Company_____

Street Address_____

City_____ Zone____ State_____

"Fifteen minutes later I was looking at one of the worst fouled-up plants I ever saw."

Marmaduke 'Dehydrates'

► LAST WEEK when George Edwards came to town Phil Swain reserved one of our private dining rooms on the 33rd floor, and all us editors had an interesting time swapping experiences during lunch.

George came up with one that I wanted to get Marmaduke Surfaceblow's ideas on. So next morning I stopped in at the old consulting engineer's office above O'Houlihan's Machine Shop & Engine Works.

The old boy seemed a little annoyed as he looked up from his roll-top desk and saw me.

"George Edwards told us about some fancy trouble-shooting I'd like to get your comments on," I began.

"BILGEWATER ON TROUBLE SHOOTING," roared Marmy, popping his safeties. "I'll tell you about a plant that needed dehydrating—and I'm the guy that did it—in record time."

With that the old gent shoved aside *The Racing Form* he had been studying, plopped his feet up on his desk, and blasted away.

"Back in 1932 I was a boiler inspector down in Maine. One of my plants was a small paper mill. The chief engineer was out the first time I called, so I doubled back on my tracks a few weeks later because I wanted to meet him and point out a few dangerous things I found in his plant.

"Arriving in town that evening, I called him at his home from my hotel. I introduced myself and mentioned some of the things I wanted to see him about next day. He answered the phone, said he had just arrived home and had a tough day.

"Then as an afterthought he said, to my utter surprise, "Glad you called, inspector, because the turbines, motors, switchboards and cables in the main engine room will have to be dehydrated.'

" 'DEHYDRATED?' I yelled into the receiver, thinking I was dragging my anchor. 'SAY THAT AGAIN.'

" 'That's right,' he came back talking as if a little tired. 'You see, sir, the sprinkler heads opened up under the roof right over that equipment.'

" 'The heads opened up?' I echoed. 'Why?'

" 'Well,' he said calmly, 'the roof caught on fire last night, so we had to break out the hose and put the roof fire out—but that fire is what opened up the heads.'

" 'Now, wait a minute,' I cut in, getting up a full head of steam. 'How come the roof was on fire?'

" 'It's like this,' he explained patiently. 'That short in the bus bars, in back of our 15-panel main switchboard, set on fire the temporary plywood shield that we put over the bus!'

" 'Hold it again, Mac,' I yelled. 'Hold it. Now—what in hell did you say about a SHORT?'

" 'Maybe you noticed those bus bars are ¼ inch thick and four inches wide,' he explained. 'Well, 15 of them burned away completely for about two feet of their length!'

" 'Batten down the hatches for a second,' I cut in again, 'and tell me WHY those bars burned.'

" 'That's easy,' he answered. 'They burned because so much moisture collected on the bus structure that the bus bars shorted explosively and knocked out all the power in the plant.'

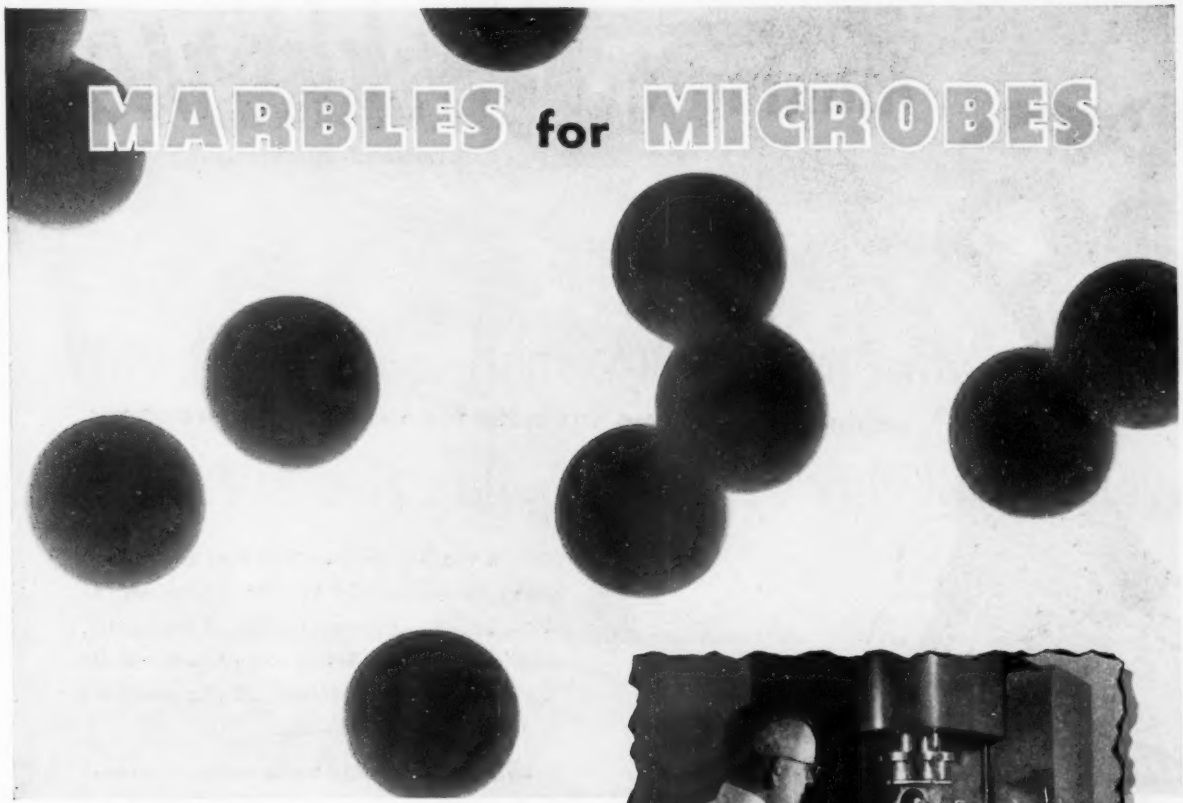
"By that time I was fanning myself with my derby and sweat was pouring down my face as though I had taken a 'green one' over the bow.

" 'Listen,' I hollered into the receiver. 'How did moisture get on those bus bars in the first place?'

" 'How?' he repeated, a little annoyed. " 'Why, it just couldn't help getting on the bus bars because it was

(*Continued on page* 220)

MARBLES for MICROBES



Above—100,000X enlargement of latex spheres used to calibrate electron microscope in Nalco Laboratories. Actual diameter of spheres is 0.25 microns—.00000975 inches! *Right*—Inserting specimen holder in vacuum chamber of Nalco electron microscope.

. . . How they assist research toward better Water Treatment

PERHAPS even too small to make good marbles for microbes, these tiny spheres help Nalco Scientists in their investigations of the microscopic realms of matter only recently made visible to the human eye by the electron microscope.

Use of the electron microscope in water treatment research is significant because it typifies the continuing efforts of the entire Nalco organization to keep the Nalco System representative of the first and best in all phases of modern industrial water treatment.

If you are not already participating in the economy and efficiency of the Nalco System in your plant, write for details on real water treatment security today.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois

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THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Nalco WATER TECHS

New reprint of A.S.M.E. Paper No. 52-A-30: *Experimental Studies of Boiler Tube Metal Temperatures: Effect of Heat Transfer Rate and Deposit Thickness*, gives technical data on high-heat-transfer-rate effects (140,000 to 300,000 Btu/sq. ft./hr.) at pressures from 250 to 2500 p.s.i. 16 pages, with tables and diagrams. Author: C. Jacklin, Director, Engineering Research, National Aluminate Corporation.

Your Copy Free Upon Request

Making a *Workhorse*

Industry's all-time favorite for long range economy

JENKINS
Fig. 106-A
Renewable
Composition Disc
BRONZE GLOBE VALVE

150 lbs. Steam
300 lbs. O. W. G.

Take a Fig. 106-A apart. It's easy to see (and show) the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Fig. 106-A not only looks better—it proves out better in performance. In any comparison, its long life, low upkeep record has never been surpassed. That is the true measure of valve cost—and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

a Champion

Why the first Renewable Composition Disc Globe Valve is still first with valve-wise buyers

Work horse of industry's pipelines is the renewable composition disc Bronze Globe. Because of the big demand, many versions of this valve are made. The buyer has a wide choice, and if he wants a valve that will just "get by" there are plenty of them.

Jenkins valve specialists have always taken a special view of this type of valve. It dates way back to the time when Jenkins introduced the *first* renewable composition disc Bronze Globe. In fact, Jenkins is still the only manufacturer of both valves *and* discs.

Jenkins engineers reasoned that the valve that has most of the work to do should have a liberal extra measure of dependability. The result is Fig. 106-A. It has all the rugged endurance of a work horse. But it also has the fine form, the lasting sensitivity of control—all the characteristic features of a champion.

That's why it is the leading choice of valve-wise buyers throughout industry. Try Jenkins Bronze Globes on your toughest services, for new installations, for all replacements. See why they are *your* best buy for lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17.

GET THIS FOLDER— Gives details of Fig. 106-A design, and "family" interchangeability. Ask your Jenkins Distributor for Form 189-A, or write Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros

One Good Valve Becomes Another . . .

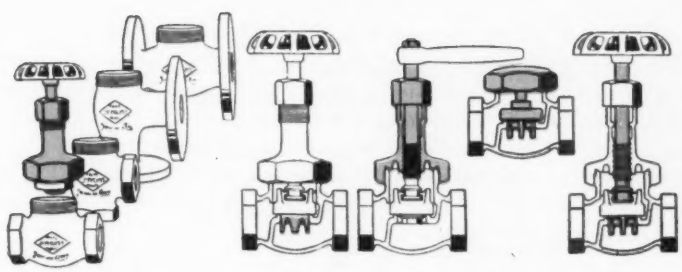


Fig. 106-A "Family" interchangeability meets 90% of Industrial Valve Needs. Trimming is interchangeable in Globe or Angle body, screwed or flanged. With a few parts, quickly assembled combinations provide a Lift Check, a Spring-loaded Check, and valves for Stop and Check, Quick-opening, or Throttling service.

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Northwest power limitation orders issued last October have been revoked by Defense Electric Power Administration. This move recognizes the end of crucial water-shortage conditions for the winter of 1952–53. In January, two provisions of the orders were suspended: a ban on use of interruptible power, and a 10% cut in use of firm power by large customers (over 8000 kwhr per week).

Successor to CMP is DMS, which is Washingtonese for Defense Materials System. New setup should take effect July 1, when Controlled Materials Plan expires.

Unlike CMP, under which steel, copper and aluminum were allocated to all users, DMS covers only defense uses. Allotments will be made to manufacturers and builders on direct Defense Dept. or Atomic Energy Commission contracts. These prime contractors will also get preference ratings to buy needed tools and components, can pass priorities along to subcontractors and suppliers.

Producers of steel, copper and aluminum will set aside specific tonnages for defense-rated users. Probable industrywide setasides for third quarter: steel 15%, copper 25%, aluminum 30%.

Defense-supporting projects will also receive priorities, but sparingly. AEC or the Pentagon will have to certify. An electric utility plant to power an atomic project, for example, would probably get a rating, others probably wouldn't. Non-rated manufacturers and builders can purchase steel, copper and aluminum in the open market, to the extent of their ability.

Molybdenum alloys for high-pressure high-temperature service are still restricted in molybdenum content, but allowable limits have been upped. For corrosion-erosion conditions, National Production Authority will consider exceptions.

Engineer shortage gets no better. Number of engineers needed in relation to production workers keeps rising as industry gets more complex: it now takes close to 200 engineers per 10,000 workers. This is up from about 115 in 1940.

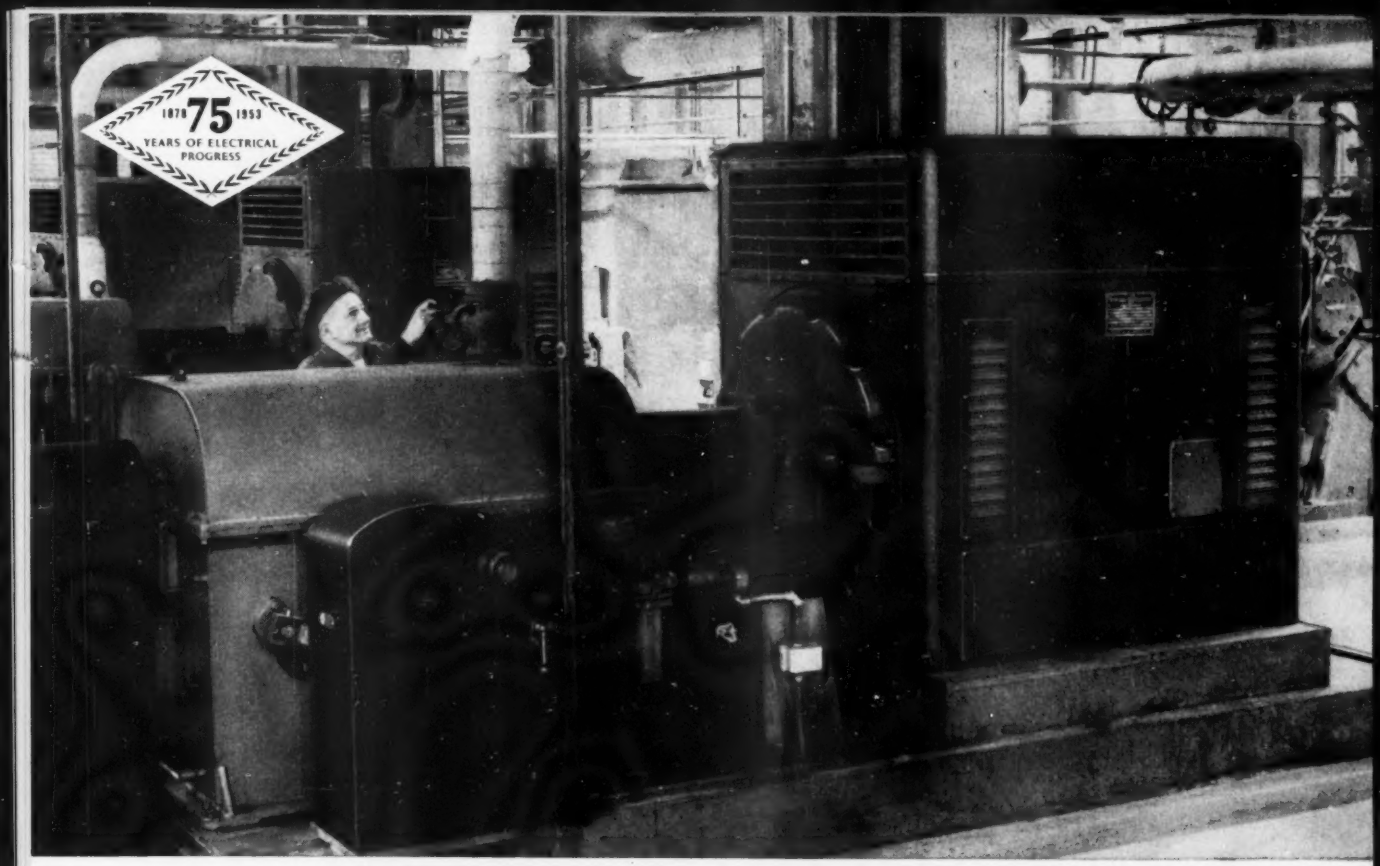
And number of engineering graduates will decline to an estimated 17,000 in 1954, before starting to rise. Something over 25,000 graduates are expected in 1956. These figures compare with annual need for some 30,000 new engineers.

Plenty of copper seems to be the word as some favorable developments in supply put this once-tight metal into a buyers' market. There's been lots of confusion, but all signs now point to lower prices when the situation stabilizes.

Two reasons for better supply: Lifting price lid on foreign copper while European demand was down stimulated imports. The end of domestic price controls brought scrap out of hiding.

New mobilization strategy seems to be in the making, but it's still hard to tell what its final shape will be. We've been spreading defense work as far as possible to gear industry for a quick shift to big production if all-out war comes. This admittedly runs up costs; new defense boss Wilson thinks it wasteful.

His program might run like this: Cancel out some high-cost producers before their contracts are completed. Allow most contractors to go ahead and fill their orders. Restrict new contracts to efficient producers. This promises more arms per dollar spent but narrows the production "base."



MODERN G-E BOILER FEED PUMP MOTORS ARE INSTALLED IN NIAGARA MOHAWK'S NEW ALBANY POWER STATION.

IN DESIGN AND PERFORMANCE—

A True Power Station Motor

When side-air-discharge motor ventilation proved impractical for large boiler fed pump service, we reversed the air flow to expel the warm ventilating air high over the pump. This prevents recirculation of discharge air . . . permits close parallel spacing of motors . . . greatly improves personnel comfort.

In addition to ventilation changes, this modern cubical boiler feed pump motor incorporates the latest advances in bearings, insulation, rotor, and stator design. It's built to serve you with the year 'round reliability the vital power industry requires.

Some of the features of the G-E drip-proof Boiler Feed Pump Motor which make it a true power station motor from top to bottom are:

STREAMLINED ROTOR construction prevents "siren" effect—built-in deflectors and large discharge chamber cut overall noise level considerably.

DUAL LUBRICATION SYSTEM combines the advantages of force-flood lubrication and self-lubricated oil rings . . . gives extra protection . . . assures long, reliable bearing life.

COMPLETE 360 DEGREE ENDSHIELD supports bearing from top as well as bottom . . . assures continuous, accurate bearing lineup. Both endshield halves are sturdy ribbed castings.

For more information contact your nearest G.E. Apparatus Sales Office or write for Bulletin GEA-5813 to General Electric Co., Section 753-3, Schenectady 5, N. Y.

Conventional motor (top) expels heated discharge air into the aisle—G-E Boiler Feed Pump motor exhausts air high over the pump.

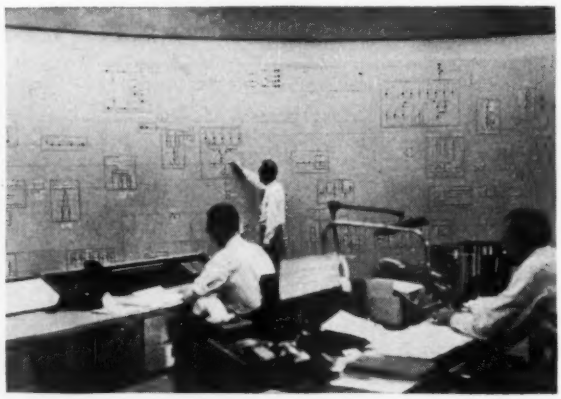
You can put your confidence in—

GENERAL ELECTRIC

READER SERVICE SECTION

POWER NEWS 150
TECHNICAL BRIEFS 152
PLANT EQUIPMENT NEWS 156
NEW FREE BULLETINS 165

POWER AND WATER functions of the Colorado-Big Thompson and North Platte projects tie together at this control board



OPERATING PROBLEMS prove complicated because all power generation is at the western end of the transmission lines

Dispatching Center Serves Three States

A newly completed dispatching center tucked away in the mountains near Loveland, Colorado, is directing flow of water and power across the plains of Colorado, Wyoming and Nebraska—a 121,500 sq mi area bigger than New York, Pennsylvania and New Jersey combined.

The Bureau of Reclamation's new Flatiron Dispatching Headquarters guides the flow of electricity and water from 11 power plants with installed capacity of 288,300 kw and 16 reservoirs with storage capacity of 3,286,000 acre feet in Colorado and Wyoming. Its 17-man crew dispatches power over a 2500-mile network of high-voltage transmission lines to 130 wholesale customers and feeds water into canals serving more than a million acres of farm land.

The Flatiron operation, known officially as headquarters for the Upper Platte System, ties together the water and power functions of the Colorado-Big Thompson and the North Platte reclamation projects. Power generated on the system totaled 732,000,000 kwh in 1952. Depending on water inflow conditions, this year's generation will be from three-quarters to one billion kwh.

The system is designed for integrated operation with the Public Service Co of Colorado, and two connections now exist between the utility and the bureau lines. A third connection will be made this fall when the Flatiron power plant is finished and put in operation.

Operating problems are complicated because all of the power generation is at the western end of the transmission lines where water flows from the Rockies onto the plains. These large transmission distances coupled with light loads cause tremendous charging current to develop on the high-tension lines. Thus 115,000 volts placed on the lines at the generating end of the system often rises to 135,000 or 140,000 volts at the end of the transmission lines.

To correct this condition, which caused home electrical appliances to burn out if not controlled, four shunt reactors and a 40,000 kw condenser were installed at the eastern end of the lines.

Water Wheel at Hydro Station Disintegrates

One of two horizontal-shaft 450-rpm water wheels driving a 30,000-kw generator flew apart at Pacific Gas & Electric's Bucks Creek hydro station on the Feather River. Of the 19-bucket wheel, one five-bucket piece, weighing 2½ tons, hurtled through the station roof and landed on a hill 70 ft away. Another, with three buckets, hit the crane rail and fell into a storage area. A third, with ten buckets, dropped into the pit. The 19th bucket has not been found.

Cause of the accident is unknown, but one piece of the disk shows signs of a crack and internal rusting which went undetected since the wheel was installed in 1928. Best guess is that one bucket let go and the resulting unbalance vibrated the wheel to destruction. Investigation may sideline the unit for up to a year, the company estimates.

A second 30,000-kw unit was not affected and remains in operation. Bucks Creek has a static head of 2562 ft, highest in the country.

For coming events see page 242

Industrial Forum Predicts Commercial Atomic Power

At a recent press conference, six directors of Atomic Industrial Forum, Inc, agreed that commercial generation of electric power by breeder reactors is likely in the next ten years. They also held that the security of our atomic secrets is far more enhanced by continuous progress and development in the field than it is by restrictive secrecy.

The Forum is devoted to encourage and foster research development, knowledge, understanding of atomic energy.

(Continued on page 240)

Reduce Solids Concentration *with* EFFECTIVE BLOWDOWN

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

COMPLETE TEST KITS for making standard feedwater and boiler water tests are supplied by Allis-Chalmers for field use. When needed, modern testing equipment and research facilities are available in A-C laboratories.

You Need An Effective blowdown schedule to reduce solids concentration and limit heat losses in your system. Planning your schedule is easier after you've read Allis-Chalmers water conditioning Bulletin 53. It tells how to choose between a manual and a continuous system. It explains factors involved in sludge removal. And it discusses effects of alkalinity and silica concentration.

Part of Practical Library

Bulletin 53 is one of a series of Allis-Chalmers bulletins on water conditioning problems. These bulletins are the result of Allis-Chalmers experience in solving water problems for every industry, as well as the company's long background in the design and manufacture of steam turbine and power plant equipment.

Get Complete Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in all water treatments. And you can get equipment needed for any system.

For your copy of Information Bulletin 53 on blowdown, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers representative consult with you on your water problems.

A-4008

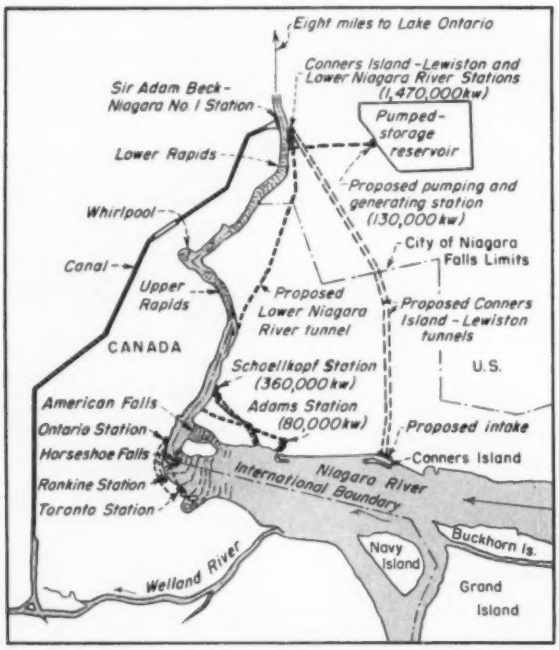
ALLIS-CHALMERS

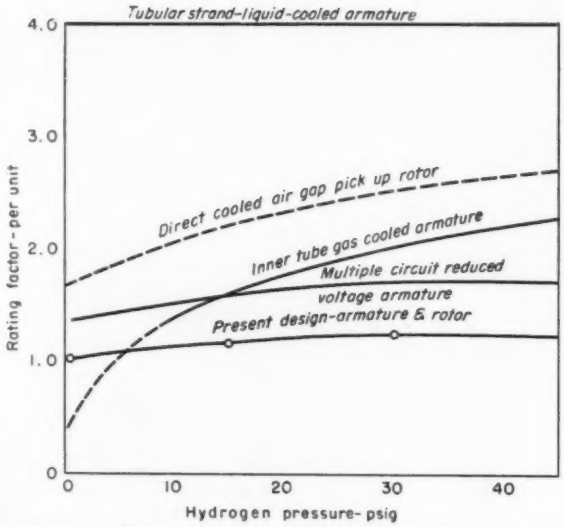
TECHNICAL BRIEFS

Latest engineering developments for busy power men

12 Digests for you on:

HYDRO POWER
ELECTRIC GENERATORS
POWER DRIVES





SUPERCHARGED hydrogen cooling has greatly reduced raw materials in construction, aided in better rating above **FIVE PUBLIC UTILITIES** propose final power development for the U. S. side of Niagara Falls to look like sketch, left

Hydro Power

American Development of Power on the Niagara River. *By Harold I Howell, Niagara Mohawk Power Corp.*

After outlining the history of power developments at Niagara Falls and the treaty of 1950 to permit increased water diversion for power generation, the author describes the engineering plans for the development on the U. S. side of the Falls proposed by five public utility companies. Based on construction costs in the early part of 1953, the complete project is estimated to cost $390,000,000. To carry out this plan the following construction sequence is recommended to give the final development shown in drawing, left, above.

1. Construct one 47-ft diameter concrete-lined tunnel about 5 miles long from Conners Island intake to the Lewiston power house. This development will use about 30,000 cfs under a head of 314 ft and will operate in parallel with the existing Schoellkopf and Adams stations. Added power capacity will amount to 675,000 kw.

2. Construct the second 47-ft diameter tunnel, which will add about 675,000 kw more capacity. Schoellkopf station will continue to operate as will Adams when water is available within treaty limits.

3. Construct the pumped-storage development to provide greater peakload output at the Lewiston power house. This will include a single 47-ft diameter tunnel 1 mile long, a pumping generating station to add 130,000 kw of generating capacity and a pump-storage reservoir of about 22,000 acre-feet.

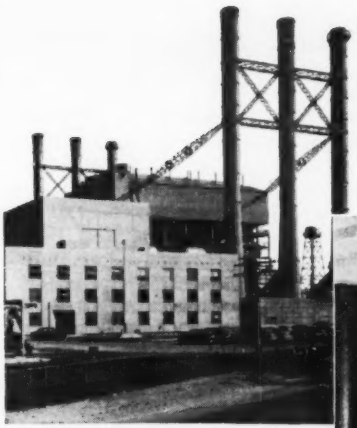
4. Construct the lower-river project tunnel about 3 miles long by 42 ft in dia. This development will add 120,000 kw and use 94-ft head in the lower river between the Schoellkopf and Lewiston power houses.

This plan will add about 1,600,000 kw of generating capacity to the two existing plants which have a total of 444,000 kw installed. The increase in annual energy generation will be about 8-billion kwhr, bringing the total on the U. S. side to about 12-billion kwhr. The proposed Niagara development can be completed in six years and power from the first step can be made available in three years after construction starts. *APC Paper, no number.*

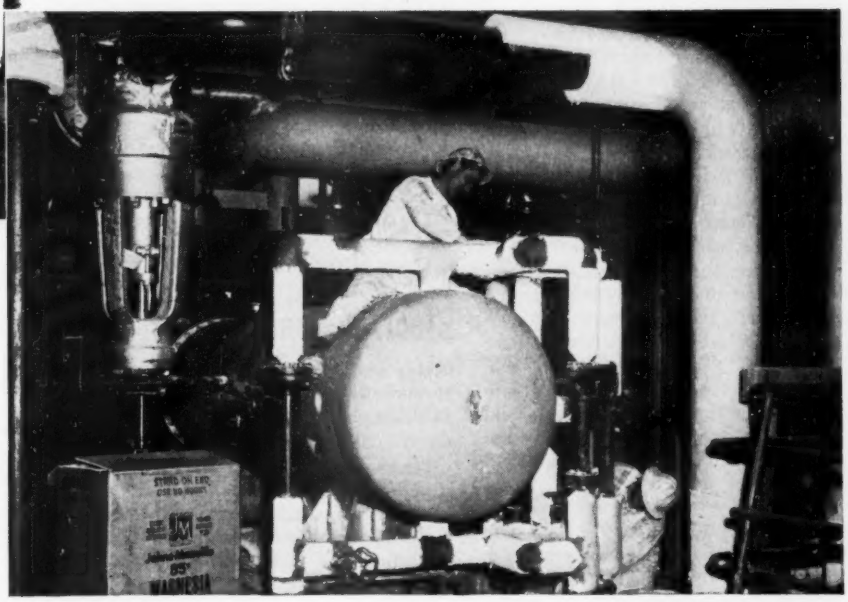
Falcon Dam and Power Plants. *By J B White, Engineer, International Boundary and Water Commission, United States and Mexico.*

Falcon Dam on the Rio Grande, a stream marking the boundary between the United States and Mexico for over 1200 miles is of interest because it is being built as a joint job of the two governments, for benefit of the two countries. The primary purpose of the dam and large storage reservoir that it will create is to irrigate land in the southerly tip of Texas and the adjacent region in Mexico. Secondary features are flood protection and hydroelectric-power development.

The dam is located 75 miles below Loredo, Texas, and 270 miles above the mouth of the river. It is a rolled-earth structure 5 miles long with 150 ft maximum height and will form a reservoir



At the new Moss Landing generating plant



(Top) Moss Landing, California steam plant of the Pacific Gas and Electric Company, designed by Stone and Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Dept.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, Western Asbestos Company of San Francisco, applying J-M 85% Magnesia to pipelines during construction of the Moss Landing plant.

P. G. and E. INSULATES WITH SUPEREX-85% MAGNESIA TO LOWER POWER PRODUCTION COSTS

When Pacific Gas and Electric Company invested $80,000,000 in its new 771,000-horsepower electric generating giant at Moss Landing, California...the insulation, like all other materials, had to meet rigid specifications. *For this important project, Johns-Manville Superex-85% Magnesia double-layer insulation was used on superheated steam pipes.*

Superex Combination Insulation consists of Superex*, a J-M insulation for temperatures to 1900F, and J-M 85% Magnesia. It was installed at the Moss Landing plant for maximum thermal efficiency and long trouble-free service. This double-layer construction, proved in over a quarter-century of outstanding on-the-job performance, utilizes the higher heat resistance of Superex next to the hot surface—the greater insulation value of J-M 85% Magnesia for the outer layer. It eliminates through joints, protects the jacket against scorching and is unharmed by expansion encountered in pipes carrying superheated steam.

J-M 85% Magnesia is the leading insulation for temperatures to 600F. It will not distort regardless of its length of service. It fits snug, stays tight. Heat savings, therefore, remain constant for the life of the equipment on which it is applied.

Whatever the insulation—it must be properly engineered and installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings.

For further information, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

Double-Layer Superex-85% Magnesia Insulation was used on superheated piping at the P. G. and E. Moss Landing plant.

*Reg. U. S. Pat. Off.

Johns-Manville FIRST IN INSULATION

MATERIALS • ENGINEERING • APPLICATION

of over 4-million acre-feet capacity. There are two identical power houses, one in the U. S. and the other in Mexico. Each designed for four 14,750-hp 163.6-rpm vertical-shaft Francis turbines driving 11,667-kva 6,900-v, 60-cycle 0.90-pf generators, of which three are being installed in each plant. It is expected that power generation of the two plants will average about 250,000,000 kwhr annually.

Practically the only difference in the two plants is in the arrangement of the intake works and penstocks. Generators in both plants will be connected to operate on a unit system. Each generator will connect to a 6.9 to 138-kv step-up transformer that in turn connects through an oil circuit breaker to the 138-kv bus. The high-tension switchyard is on the roof of each plant and has a main and transfer bus, with the usual complement of disconnect switches, current and potential transformers.

Estimated cost of the dam and two power plants is $49,205,000 excluding certain items borne separately by each government within its own territory, such as the acquisition of lands, relocation of highways and utilities, construction camps and access roads. It is expected that the plants will be ready for operation about April 1, 1954. *APC Paper, no number.*

An Evaluation of Our Water Sources. *By A M Buswell, Chief, Illinois State Water Survey.*

This paper reviews the possibilities of increasing our available water supply with particular reference to the State of Illinois. The author's conclusions are: (1) present water consumption is rapidly exceeding the capacity of developed supplies in many localities, (2) demands for water are increasing at rates which may reach the limit of our ultimate resources in the not too distant future unless new methods for water development and use are worked out, (3) present methods of evaluating our water resources are very inadequate and inaccurate. This is a sentiment widely expressed by today's water experts.

In view of the obvious need for more complete information on our developable water resources, the Illinois State Water Survey aided by representatives of the States of Indiana, New Jersey and Ohio, undertook in 1951 water resource studies. Examining the Federal side of the picture it is interesting that the federal water programs over the nation cost $13,200,000 in 1949. This was divided: Weather Bureau $4,800,000, Geological Survey $8,380,000, transferred from other interested agencies $4,740,000.

The need for increased interest by public agencies in water resource work is clearly called for. A greatly increased program is amply justified when we consider that our developed water supplies are valued at $7,300,000,000 per year while the amount spent on collecting information on this resource is only $14,000,000 or less than 0.2 of one per cent. New techniques developed to solve our water problems include: groundwater recharge, radar and statistical analysis. *APC Paper, no number.*

Electric Generators

Design and Application of Large Steam Turbine Driven Generators. *By C E Kilbourne and J B McClure, General Electric Co.*

Progress in the art of generator design depends fundamentally on the extension or removal of one or more of the basic physical limitations which determine how these machines can be satisfactorily built. The problems involved cover a number of areas of engineering including, basically: magnetics—how to carry more flux; electricity—how to conduct current better; dielectrics—how to contain voltage better; fluid flow and thermal dissipation—how to convey heat; and mechanics—the construction features to enable the proper performance of the preceding functions. Technical advances have recently been made in several of these areas and the extension of the corresponding limitations is the story of today's progress.

The rotors of large turbine generators, for example, are now generally made of solid alloy steel forgings. The original development of these parts of necessity emphasized the physical characteristics of the forgings above all else as it is always essential that uniform high physical strength exist throughout the rotor. This was done with the use of alloying elements, principally nickel, with some additions of chromium, molybdenum, and occasionally vanadium, and an elaborate heat treatment. These elements are generally detrimental to obtaining a high intrinsic saturation limit in a forging and often caused considerable variation in the magnetic characteristics of different rotors. Consequently, they tended to limit the flux carrying ability of the rotors.

After the problems of physical characteristics had been solved, an extensive investigation was carried on to improve both the magnetic limit and the uniformity of magnetic characteristics. It was found that a careful control of the carbon and chromium content, plus a revised heat treatment, would not only provide just as good physical properties as had been obtained earlier, but also would improve both the flux carrying ability and the magnetic uniformity of the rotors. The results have been excellent. Cases of high excitation requirements, which occasionally occurred earlier, have been eliminated and the magnetic loadings of the rotors have been increased.

A similar development has taken place for the magnetic parts of the armature. In this case, oriented-grain strip steel has replaced non-oriented sheet steel. This is advantageous for turbine generators because the large, heavy core sections, back of the armature teeth, can be materially benefited by the new material. The loss in this part, which is one of the major losses in the machine, can be reduced to between 65% to 75% of its previous amount, or more flux may be carried with the same loss, or a compromise between loss reduction and flux carrying ability may be used. Thus the magnetic parts of the armatures can be made smaller than they have been before, or, conversely, the same sized parts can be made to produce a greater output.

The ability to get more out of a given size machine is perhaps more spectacular than a decrease in dimensions of machines that have already

(*Continued on page* 200)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Institute of electrical Engineers, winter general meeting, Statler Hotel, New York, N. Y. Jan 19-23, 1953. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., March 24-27, 1953. Identified by initials APC and obtainable in proceedings printed and distributed by R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill. $6.00.

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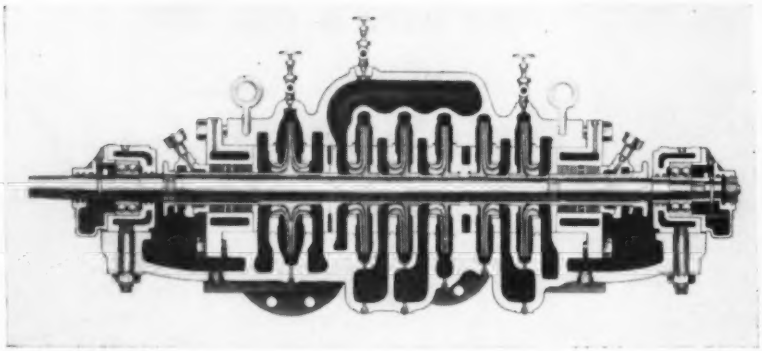
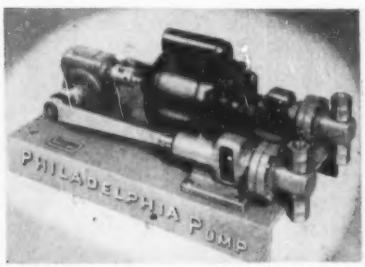


Centrifugal Pumps for High-Speed, High-Pressure Operation

605 • Five, six and seven stage *Thrustfre* centrifugal pumps have capacities up to 1300 gpm, discharge pressure to 1200 psig, 2½, 3, 4, and 5 in. sizes. First stage impeller is double suction type, enabling pump to handle hot water with lower net positive suction head. Both stuffing boxes are subject to low pressure—suction pressure only at one end, first stage pressure only at the other.

Pennsylvania Pump & Compressor Co, Easton, Pa.



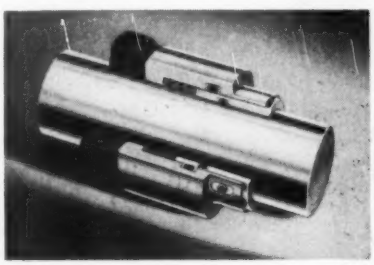
Proportioning Pump

618 • New controlled capacity proportioning pump allows removal of moving parts through the crosshead without breaking piping connections. Packing gland is open at both ends to simplify replacement of packing and assure even take-up. Grease lantern ring can be changed to a water seal for handling suspended solids or corrosives. Pump can be used in single, dual or multiple combinations.

Top suction and discharge valves are spring-loaded, stroke length can be adjusted for capacity regulation while unit is in operation.

Pump is low-capacity, high pressure reciprocating plunger type. Capacities range from 5cc per hr to 128 gph. Pressure ranges to 20,000 psi.

Philadelphia Pump & Machy Co, Wynnewood, Pa.



Mechanical Seals

637 • New "O" ring mechanical seals for rotating pump shafts are designed to provide leakless operation. Type O is an unbalanced seal for pressures up to 200 psi, type OB a balanced seal for pressures up to and over 1000 psi. Both types available with single or multiple spring, in either pin-drive or sleeve-drive construction.

Type O is furnished for packing spaces 5/16 in. and larger, type OB for spaces ⅜ in. and larger. Rings are *Teflon*, Buna-N, neoprene or silicone. Metal parts can be any suitable material.

Garlock Packing Co, Palmyra, N.Y.

Plastic Pipe

647 • Complete line of plastic pipe is said to have outstanding impact resistance and good resistance to a wide variety of corrosives. Made of styrene, it is available in sizes from ½ to 6 in. OD, in 10 and 20 ft lengths.

Atlas Mineral Products Co, Mertztown, Pennsylvania.

For more data on these items, use post cards, p. 165. Identify your request with item number.

Centralized Lubrication System

623 • Automatic pumping unit DC-20 provides centralized lubrication for single machines. Unit dispenses oil or greases automatically. All parts including ¼ hp motor and drive are mounted on common bedplate. Complete system includes pumping unit, two main supply lines, *Dualine* measuring valve for each bearing, and discharge line connections from the measuring valves to the bearings.

Electric time switch controls frequency of operation. Six models available for oil or grease lubrication. Bulletin 39.

Farval Corp, 3249 E 80th St, Cleveland 4, Ohio

High-Vacuum Pumps

641 • Mechnical high-vacuum units will pump condensible vapors without oil contamination or loss of pumping capacity. Rotary gas ballast pump uses imported pump units with American motors, pulleys and controls.

This pump prevents vapor condensation by keeping vapor pressure below condensation pressure. A small quantity of air is bled into pump after intake, as compression is about to begin. Power requirements equal those for conventional mechanical pumps. Available in single-stage units with capacities from 2 to 400 cfm, compound units from 2 to 15 cfm, and combination units from 30 to 400 cfm.

National Research Corp, 70 Memorial Drive, Cambridge, Mass.

Air Check Valve

643 • *Technocheck* valve opens or closes gas or air lines quickly and automatically on low pressure differential. Standard valves available for pressure to 50 psi, 200 F. Special valves for higher temperatures and pressures.

Unit is seatless. Two elliptical plates, covered with pliable material and hinged at the center, assume a streamlined "feather" position when valve is open, close bore of the chamber if flow reverses.

Techno Co, 28 W 12th St, Erie, Pa.

(*Continued on page* 158)

NO BONNET JOINT MAINTENANCE HERE

CRANE LIP-SEAL BONNET VALVES
PATENTED
STAY ABSOLUTELY TIGHT!

1500 and 2500-Pound Globe and Angle Patterns

A small bead of weld metal completely seals the bonnet joint against leakage—in this revolutionary small steel Lip-Seal Bonnet Valve by Crane. Yet the weld carries no mechanical load at rated pressures. If dismantling for inspection is desired, the weld is easily ground off . . . easily replaced. And like its big and famous brother, the Crane Pressure-Seal Bonnet Valve—this new Crane Lip-Seal Bonnet Valve brings many another important refinement. You get a compact, weight-saving structure without sacrificing strength or reducing seat area—a more rigid swivel disc-stem connection—durable plug-type disc—Stellite-faced seating surfaces—and many other features.

Globe and Angle patterns; socket-welding or screwed ends, sizes ½ to 2-inch in choice of steel as required. Full details in Circular AD1902—sent free on request—or check with your Crane Representative.

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CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 156

Test Instrument Checks Current-Actuated Protective Devices

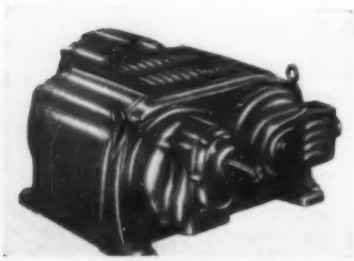
602 • Portable high-current industrial *Multi-Amp* model 1010 checks operation of circuit breakers, overload relays, etc, before, during or after installation, without danger to other equipment.

Unit is adjustable in stepless increments with fingertip control. Manufacturer claims it will check both devices with high impedance and low current and those with low impedance and high current.

To test an overload relay, connect it to the proper *Multi-Amp* terminals, adjust amperage to desired test value, meanwhile observing a current indicator and a timer. If relay trips according to manufacturer's time-current curve, it will do protective job it's supposed to do.

Tester is rated at 1 kva, operates on 110 v, 60 cycle ac, 0 to 10 amps. Output can be adjusted from 0 to 500 amps in 5 ranges. Bulletin available.

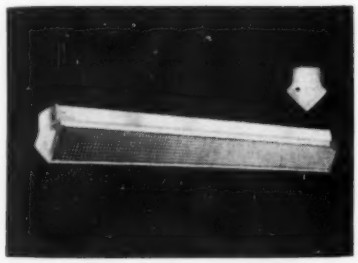
Multi-Amp Corp, Harrison, N.J.



Variable-Speed Drive

612 • Horizontal assembly of *Varidrive* motor has all the features of the company's upright models, is available up to 30 hp. Speed variations up to 10:1 are available.

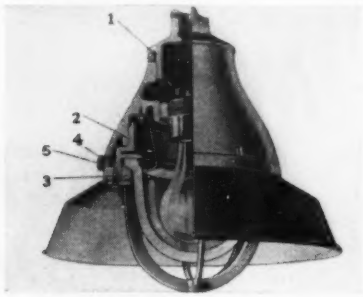
U. S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.



Corridor Lighting Fixture

640 • Unit is said to take care of asymmetrical lighting requirements in wide halls and corridors. Sidewise illumination is broad, lengthwise the brightness is shielded by 45-deg louvers. *V-C-U* corridor light is available in 4, 8 and 16 ft lengths, wired rapid-start, conventional or slimline, in one or two rows of lights.

Edwin F Guth Co, 2615 Washington Ave, St. Louis 3, Mo.

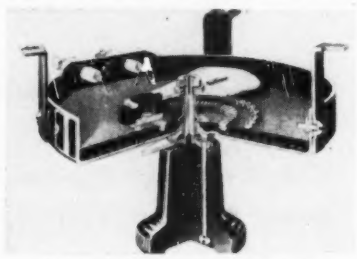


Explosion-Proof Fixture

646 • Series EV explosion-proof industrial lighting fixture has improved threaded connections to prevent liquids, vapors or dirt from entering bulb and receptacle areas.

Unit is claimed to be easier to install and relamp because of its light weight and improved sealing. All types of reflectors are available on 100, 150, 200, 300 and 500 w fixtures.

Crouse-Hinds Co, Syracuse 10, N. Y.



Pressed Steel Rheostats

604 • Bulletin 60A rheostats are available in two distinct types, S (standard) and M (multi-step), with 6, 8 and 13 in. diameters. Maximum summation watt ratings are 330, 450 and 1000 respectively. Control steps per plate range from 41 to 161. Both types are obtainable with a wide range of resistance values and current tapers. Manual or motor driven operation is possible.

Manufacturer claims the rheostats furnish smoother operation, lower operating torque and more control steps than previous designs.

Ward Leonard Electric Co, Mt. Vernon, N. Y.

For more data on these items, use post cards, p. 165. Identify your request with item number

Fuel Oil Additive

613 • Liquid chemical compound *Atom-IX* changes molecular structure of all fuel oils. Manufacturer claims this permits more complete combustion, results in higher thermal efficiency with less carbon residue. Condensation is reduced, sludge broken up.

Bell Laboratory Inc, Orlando, Fla.

(*Continued on page* 160)

2 new Autronic packages help you control and/or record temperatures instantly . . . accurately . . . inexpensively

No matter what the process . . . no matter how stringent the control requirements—if it can be done with a pneumatic or electro-mechanical system, it can be done better, faster, easier and generally at less cost with one of the two new *Autronic* Packages.

Since the *Autronic* System is *all-electronic,* it eliminates transmission lags . . . places no restriction on location of components. Other plus features are flexibility for multiple control systems . . . interchangeability of components without recalibration . . . elimination of expensive-to-install, troublesome air lines.

So if temperature control and/or recording is your problem solve it the *all-electronic* way—with a Swartwout *Autronic* Package. Literature and prices on request.

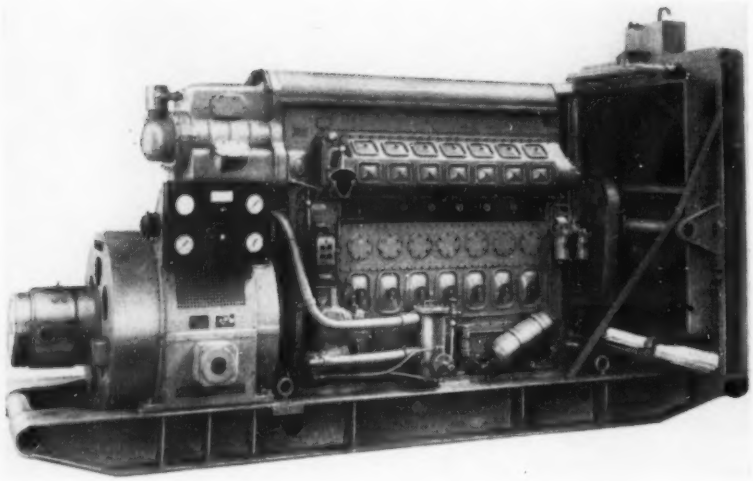
A-7073

Swartwout *Autronic* **CONTROL SYSTEM**

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12 • OHIO

More EQUIPMENT NEWS

Begins on page 156



Heavy-Duty Diesels for 225- to 750-Hp Service

601 • Model 38F5¼ opposed-piston engine, rated 75 hp per cylinder at 1200 rpm, meets demand for a compact, heavy-duty diesel for stationary, marine, railroad and other specialized applications in the 225 to 750-hp range. Full "OP" line now extends from 225 to 2400 hp. All can be equipped to operate as oil-burning diesels, dual-fuel, or spark-ignition gas engines.

New 5¼x7¼ engine is designed for continuous service with rugged construction and conservative piston speed and bearing loads. Yet 225-hp unit weighs only 7100 lb, can be skid-mounted. Marine units have reverse-reduction gears.

Cylinder block is welded of flame-cut steel sections, stress-relieved and magnafluxed. Air receivers and ducts from rotary-type scavenging blower form an integral part of the block, add to its rigidity. Bearing saddles, also an integral part of the block, are line bored. A bevel-gear-driven, flexible, vertical drive connects upper crankshaft to lower. Part of upper shaft power drives scavenging blower. Crankshafts are high-strength alloy cast iron, cored for lightness and with integral counterweights. Thrust bearing is at drive end. Precision main bearings are aluminum alloy; forged-steel caps mortise into frame.

Interchangeable cylinder liners have steel water jackets fitted around middle where they also support combustion forces. Cooling water flows through fluted passages. Scavenging air cools upper part of liners; water circulating in exhaust-manifold housing cools lower part. Inlet and exhaust ports are located around entire liner circumference. Slanted inlet ports promote increased turbulence.

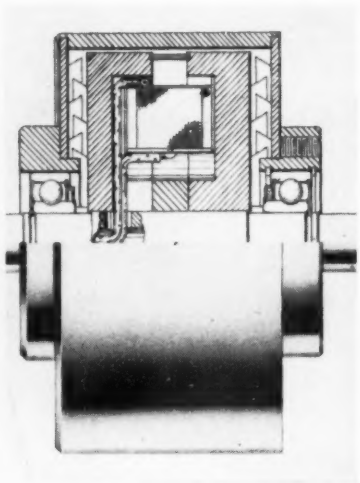
Upper and lower pistons are completely interchangeable. Each has three compression and three oil rings. A removable piston-pin insert supports hollow full-floating pin. Piston-cooling oil flows through passages between insert and inner piston wall.

Alloy connecting rods are drop-forged. When engine operates at part load, output of positive-displacement scavenging blower is reduced by an air bypass valve. This minimizes blower power requirements. Blower supplies air receivers on both sides of engine; scavenging is uniflow. Exhaust manifolds, one on each side, are water-cooled and removable.

Entire fuel system, except supply tank, is engine mounted. Positive-displacement rotary-gear-type pump supplies fuel to individual injection pumps, operated from camshaft on control side of engine. Nozzles are of the pintle type. Engine has a complete pressure-lubrication and piston-cooling system, and a closed soft-water cooling system. A raw-water system is used to cool soft water and lube oil.

One lever controls starting, running and stopping. In an emergency, a pushbutton control provides instant shutdown. Engine is fitted with a hydraulic governor and an overspeed governor.

Fairbanks, Morse & Co, 600 S Michigan Blvd, Chicago, Ill.



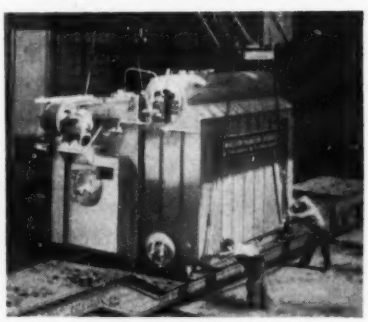
Magnetic Particle Clutch

635 • *Dynamatic* drive consists of two independent rotating members, a driving element and a driven element. The two members are separated by a space filled with small ferro magnetic particles (stainless steel). When one member is energized, the particles polarize and bind together, binding the rotating members together with a proportional force.

Advantages claimed include smooth engagement, continuous operation with negligible wear, instantaneous response, operation as clutch or brake.

Clark Mfg Co, 1830 E 38th St, Cleveland 14, Ohio

For more data on these items, use post cards p. 165. Identify your request with item number



Packaged Boiler

620 • Type VP packaged water-tube boilers are designed to operate up to 250 psig, with capacities from 4000 to 30,000 lb per hr. Unit has two-drum, vertical-bent-tube arrangement with a high ratio of furnace-wall cooling to furnace volume. Firing is oil or gas or combination. Unit employs a centrifugal-type forced-draft fan, requires neither an induced-draft fan nor a high stack, manufacturer says. Automatic control system is standard.

Combustion Engineering-Superheater, Inc, 200 Madison Ave, N. Y. 16, N. Y.

(*Continued on page* 162)

Wireway

626 • New type of wireway is designed to speed and simplify installation. Only two screws are required to fasten the cover to any one section. All other cover fasteners are of the lock type. Sections are joined by connectors, tees and elbows, each requiring only one screw which locks a hook and slot arrangement.

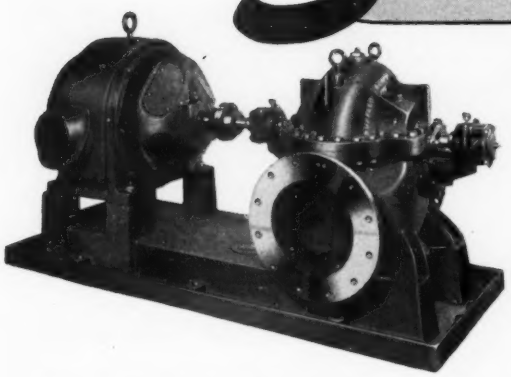
Connectors and other fittings have removable face plate permitting wires to be laid in after completion of wireway installation.

Available in lengths from one to 8 ft, with cross-sectional sizes 4 x 4, 4 x 6, 6 x 6, and 8 x 8 in.

Trumbull Electric Dept, General Electric Co, Plainville, Conn.

"Buffalo" *Tips on Better Pumping*

3 TYPES of PUMPS and what each offers you —

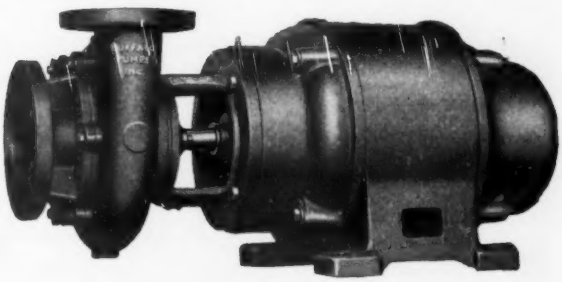


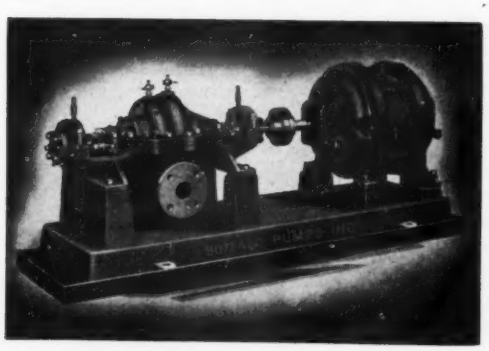
1. DOUBLE SUCTION

This "Buffalo" Pump offers a high degree of efficiency in pumping large volumes of clear water. Available in capacities for 10 to 10,000 gpm at up to 300 ft., these pumps are hydraulically balanced—water entering both sides of the impeller in equal volume and pressure. Bearings on each end of shaft mean extra long wear. Horizontally divided casing makes for extreme accessibility in inspection and servicing. Full details in BULLETIN 955-P.

2. CLOSE-COUPLED

Here is a ruggedly compact pump for those "close-quarters" installations. Pump and motor are rigidly mounted together with impeller on motor shaft, which means *permanent alignment.* "Buffalo" builds these pumps in a variety of alloys for specific liquids, with threaded or flanged inlets and outlets. Pump casing may be rotated, or removed for inspection—an important maintenance factor. WRITE for BULLETIN 975-B.





3. MULTI-STAGE

Each extra stage adds pressure! That's why pumps like these "Buffalo" Type "RR" (2 and 4-stage models) operate efficiently against high pressures (500 psi or 1500 ft. heads). These "Buffalo" Pumps have proven themselves very durable in boiler feed and other clear water installations. Bearing support on both ends of the shaft—rugged, horizontally divided casing—solid, rigid base—all contribute to easy maintenance and long life. For further details, write for Bulletin 980-B.

BUFFALO "Buffalo" PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

More EQUIPMENT NEWS

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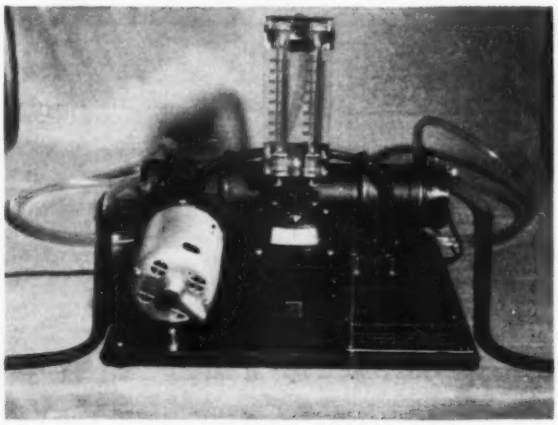


Air Filter Tester

648 • *Dill dust-spot tester* is designed to measure accurately efficiency of air filters on the job rather than in laboratories of filter manufacturers.

Apparatus consists essentially of drawing samples of dirt and cleaned air through filter paper. Efficiency of a filter is determined by amount of light transmitted through the filter paper, measured by photoelectric instruments.

Trion, Inc, 1000 Island Ave, McKees Rocks, Pa.

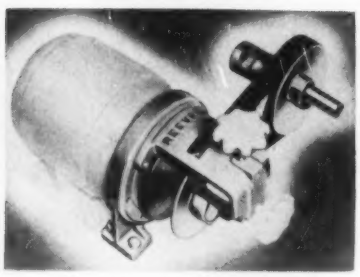
CHECK THESE TOO! . . .

Iodine titration reagent . . . . . p 172
Isolated phase bus . . . . . p 176
Power supplies . . . . . p 180
Exhaust head . . . . . p 182
Mercury manometer . . . . . p 188
Plastic centrifugal pump . . . . . p 192
Skylight . . . . . p 194
Direct-drive fan . . . . . p 196
Oil-free compressor . . . . . p 198

Portable Electric Arc Welder

617 • *Royal arc* hand portable welder uses 110/220 v ac, has heat range of 15 to 200 amps. Unit uses electrodes from 3/64 to 5/32 in., has a 50% duty cycle, manufacturer claims. Unit welds any metal up to extra-thick steel plate, can also be used for brazing, soldering, cutting or preheating using either the metallic arc or carbon arc process.

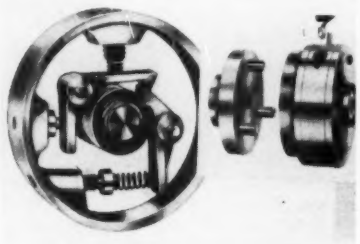
Royal Equipment Corp, 906 Main St, Burbank, Calif.



Variable-Speed Drive

632 • *Flexi-speed* drives may be mounted in almost any position around the driven equipment, may drive in any direction, and can deliver any desired speed within ratio of 8 to 1. Speed-control handwheel can be parallel to motor shaft or in any of 8 positions perpendicular to it. Units are available in ½, ¾ and 1 hp capacities. Bulletin V-532.

Reeves Pulley Co, Columbus, Ind.

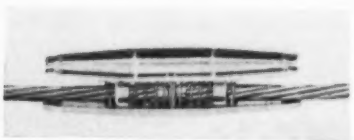


Overload Release Clutch

634 • New clutch has instantaneous trigger action and is designed to allow machines to resume operation at the exact cycle point of release. Unit is permanently lubricated, can be used over a wide range of speeds and shaft sizes, manufacturer claims.

Overload Release Clutch Co, Inc, Dept E, 1162 Stuyvesant Ave, Irvington, N. J.

For more data on these items, use post cards p. 165. Identify your request with item number.



Cable Splice

636 • New 55 series *Straightline* splice requires conductors to feed through the jaws. There are openings only at tube ends; pilot cups in each opening guide the conductors home, preventing false grip.

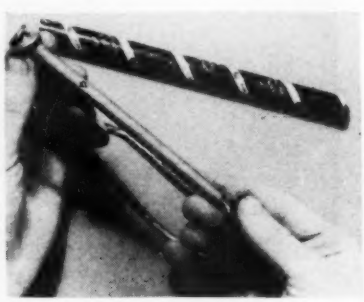
Splice is made of copper and copper alloys for copper conductors, aluminum and aluminum alloys for aluminum wires.

Reliable Electric Co, Mr F A Leach, 3145 Carroll Ave, Chicago 12, Ill.

Thermostatic Trap

615 • Type 72 and 73 bronze construction traps available in ½ and ¾ in. sizes, pressures 0 to 200 psi. Capacities range from 1900 lb per hr at 5 psi to 11650 lb per hr at 200 psi, with valve open.

Sterling Engineering & Mfg Corp, 117 Business St, Hyde Park 36, Boston, Massachusetts.



Fuse Links

649 • New lines of standard distribution fuse links are electrically and mechanically interchangeable with other makes of EEI-NEMA standard units. Features include low melting temperatures, continuous current-carrying capabilities in excess of ratings, and long auxiliary tubes.

Line includes both type K (fast), with

(*Continued on page* 172)

The RIGHT DRAFT for Any Combustion Condition

...Stepless, Wide Range Speed Control of Direct Coupled Draft Fans

When Type 257 Liquid Rheostats control the speed of boiler fans driven by wound rotor motors you get:

- Immediate response to varying draft conditions.
- Smooth, continuous, *stepless* speed control.
- Equal sensitivity over the entire operating range.

HOW IT WORKS. Motor speed is varied by increasing and decreasing resistance. This is accomplished by raising and lowering electrodes and the level of current-carrying electrolyte. A pilot device transmits draft condition to a lifting mechanism which controls electrode position and electrolyte level. A full resistance range is provided in only 10 inches of electrode travel. The basic principle of liquid rheostat operation plus the utilization of specially engineered electrodes gives a linear relationship between motor speed and electrode travel over the complete rheostat range.

Since the rheostat is not mechanically connected to the motor it may be located to suit the most convenient plant layout. For complete details, contact your Allis-Chalmers representative or write for leaflet 14S7544. A-4066

ALLIS-CHALMERS

Milwaukee 1, Wisconsin

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 1 | JUNE 1953 | Number 3

Boiler Scale Formation And Control Subject Of Paper by Rivers

In a recent paper, "Concentrating Films: Their Role in Boiler Scale and Corrosion Problems," H. M. Rivers, Director of Engineering Service for Hall Laboratories, discusses the theory of how and why highly concentrated films form on steaming surfaces, the mechanism of steam generation and scale formation, characteristic effects of concentrating films, and problems associated with degree of film concentration.

Mr. Rivers points out that water consultants are responsible for treating boiler water so that concentrating salts do not crystallize out of solution, or precipitate in forms which will accumulate continuously as solid deposits. Further responsibility: natural constituents or added chemicals in boiler water must not give trouble because of decomposition or volatilization under "film" conditions; and corrosive concentrations of free caustic must be safely avoided.

On the other hand, boiler makers must design for heat input rates which limit tendency toward excessive concentrations, and provide adequate circulation and turbulence to assure rinsing of all steaming surfaces.

Write for your free copy of this informative paper.

Radar Plots Course Of Illinois' Water

The greatest water resource of the State of Illinois lies in the air moving across it, Dr. A. M. Buswell, chief of Illinois State Water Survey, reported at the recent American Power Conference.

Radar tracks the release of this water to land surface as rain from thunderstorms. Not only are storm paths logged, but the amount of rainfall can be estimated.

Accumulation of such data provides a basis for future efforts to trap more rain.

CONSULT WATER SPECIALISTS BEFORE BUILDING!

Future Water Problems are solved in planning stage

Calling in the specialists of Hall Laboratories before a plant is built can save many dollars and much time. Hall engineers study plant requirements and needs, and come up with important recommendations which can then be incorporated in the plant as it is built.

Consider a recent instance. Hall was called in by the consulting engineers of a large, New York State manufacturing company that had decided to construct a plant in California. The problem involved was the proper treatment of the local city water supply, for use in boilers at the new plant. Changes in the available water would occur frequently due to the mixture in the system of water from four different sources, all varying widely in composition. These changes could markedly alter the composition of the plant's water supply within less than an hour's time.

To properly prepare this water, a flexible pre-treating system was recommended by Alex Henricks and approved by his associates on the Hall headquarters staff. Designed to insure good quality water under any conditions, the equipment suggested was simple to operate and sized so that capacity would be adequate regardless of incoming water composition; yet frequent attention would not be required to keep the system in proper operation.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Inc., P.O. Box 1346, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Don't waste it.

Water Important Topic Of ASME Meeting in L. A.

Major interest appears to focus on three papers dealing with corrosion produced by condensed steam, but other water problems are not neglected at the two sessions sponsored by the Joint Research Committee on Boiler Feedwater Studies and the Power Division at the mid-year meeting of the American Society of Mechanical Engineers at Los Angeles, June 29 to July 3.

Woolen Yarn Dyer Improves Cleaning, Dyeing Operations With Hall Technique

Unsatisfactory yarn scouring, plus the intermittent need for 35% more acid in dyeing operations than tests indicated should be needed, plagued this yarn dyeing concern, a new client of Hall Laboratories.

Noting that dye kettles were heated with direct-contact steam from a low-pressure boiler, the Hall engineer checked steam for carryover of alkaline boiler water. At peak load, samples were heavily contaminated; even at normal load, carryover was appreciable.

The Hall engineer recommended using Hagan Anti-Foam to reduce steam contamination. Now, even for heaviest loads, steam contains less than 3 ppm dissolved solids, higher boiler water solids are carried with resulting savings in water, heat, chemicals.

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

Want quick direct-from-manufacturer service?

USE THESE CARDS

- **First check what you need: more information on a new product or an ad, copies of free catalogs, bulletins**
- **Then describe the product, or literature desired. Give model numbers, bulletin numbers wherever you can**
- **Be sure to write in number of page on which item appeared, and issue of POWER in which you spotted it**
- **Finally, address reverse side of card to the manufacturer concerned**

If you like this quick, direct-to-manufacturer service, we'll gladly send you a supply of cards

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330 West 42nd Street
New York 36, N. Y.

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Send me these FREE Catalogs and Bulletins...

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Street Address.....
City, State.....

Please use before October 1, 1953. Void after this date.

GENTLEMEN: Please send me, without obligation, further information on the following: *(Check one and describe)*

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Describe item here

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Company.....

Street Address.....

City, State.....

Please use before October 1, 1953. Void after this date.

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☐ NEW PRODUCT ☐ ADVERTISEMENT ☐ LITERATURE

_____
Describe item here

_____

It appeared on page _____ of the _____ issue of POWER.

My Name .....
Please print

Title .....

Company .....

Street Address .....

City, State .....

This month's FREE Literature

AIR CONDITIONING, HEATING, VENTILATION

1 **ELECTRIC DEHUMIDIFIERS**—tables, instructions to find minimum dehumidifying equipment needed, lists 21 applications. 6 pages, Bulletin 531. Remington Air Conditioning, Remington Corp, Auburn, N. Y.

2 **AIR HANDLING UNITS**—complete specs on central station units and all accessory equipment, selection tables. 20 pages, Bulletin 710. Bush Mfg Co, West Hartford 10, Conn.

3 **UNIT HEATERS**—13,600 to 204,000 Btu per hr, and electric duct heaters from 25,500 to 204,000 Btu per hr. 8 pages, Bulletin E-1. L J Wing Mfg Co, Linden, N. J.

BOILERS AND ACCESSORIES

4 **GAS BURNER**—for gas firing packaged automatic boiler is of premix design. 12 pages, Bulletin 1218. Orr & Sembower, Inc, Reading, Pa.

5 **AIRFOIL CENTRIFUGAL FANS**—with airfoil shape blades for mechanical draft, high velocity air conditioning, heavy duty industrial and vehicular tunnel applications. 8 pages, Catalog 1320. Westinghouse Sturtevant Div, Dept T-866, 200 Readville St, Hyde Park, Boston 36, Mass.

6 **AUTOMATIC PACKAGED BOILER**—to 250 hp, off-center firing, 5 sq ft heated surface per rated hp. 4 pages, Bulletin EC-1152. Dutton Boilers, Div Hapman-Dutton Co, Kalamazoo, Mich.

7 **SCOTCH-MARINE BOILERS**—from 12 to 125 hp, burners for all gas and oil fuels. 10 pages, Bulletin A-104. Eclipse Fuel Engrg Co, Rockford, Ill.

8 **DRY FLY ASH PUMPS**—for central station or industrial use; also rotary air compressors and fly ash coolers. Bulletins F-K-16, C-5 and PMC-1. Fuller Co, Catasauqua, Pa.

9 **FLAME FAILURE SAFEGUARDS**—for oil, coal or gas; uses light-sensitive cell. 4 pages, Bulletin 523. Ess Instrument Co, 96 S Washington Ave, Bergenfield, N. J.

10 **STEAM BOILER UNITS**—fully automatic, oil, gas, or both, high and low pressure steam, low pressure water. 16 pages, Bulletin 509. Johnston Bros, Inc, Ferrysburg, Mich.

11 **REFUSE BURNING**—separately or in combination with rotary stokers. 24 pages, Bulletin 505. Detroit Stoker Co, General Motors Bldg, Detroit, Mich.

ELECTRIC AND MECHANICAL CONTROLS

12 **PUSH-PULL CONTROL SYSTEMS**—design data using typical control problem. 4 pages, Bulletin AD-335. Simmonds Aerocessories, Inc, Tarrytown, N. Y.

13 **LIQUID LEVEL**—controls and gages, electronic, no moving parts. 4 pages. Thermo Instruments Co, Belmont, Calif.

14 **PRESSURE TRANSMITTERS** — employ electrical transmission of data, 0.0 to 0.5 v ac output. 4 pages, Bulletin A-705. The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

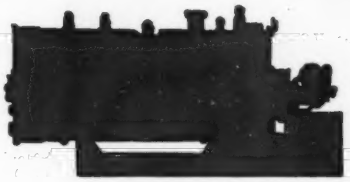
ELECTRICAL EQUIPMENT

15 **CLASS H INSTALLATION** — extra thin, roll, sheet or tape form, to 180 C. Electro-Technical Products, Div of Sum Chemical Corp, Nutley 10, N. J.

16 **MOTOR APPLICATION CATALOG**—covers selection, application and construction, complete specs, performance data. 24 pages. The Louis Allis Co, Milwaukee 7, Wis.

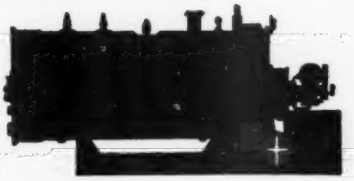
(Continued on page 252)

HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



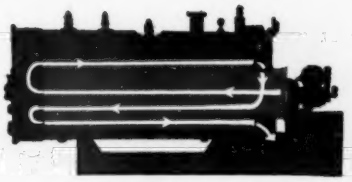
A COMPLETE PACKAGE

Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.



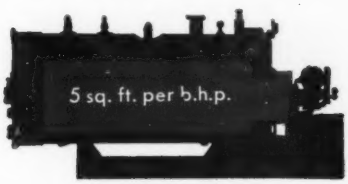
INDUCED DRAFT THAT'S BUILT-IN

... eliminates need of an expensive chimney ... Multiple fans draw evenly on all tubes, reducing maintenance.



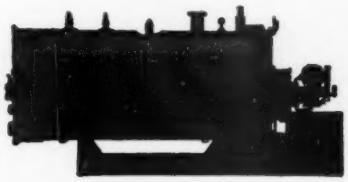
4-PASS, DOWN-DRAFT DESIGN

High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.



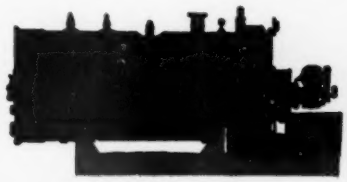
AMPLE HEATING SURFACE

A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.



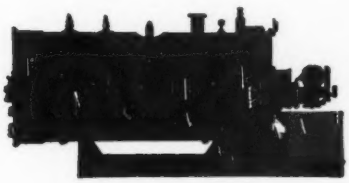
RESERVE CAPACITY

Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.



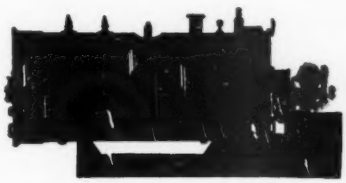
NO EXPENSIVE FOUNDATION

Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.



BUILT-IN CONTROLS

All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.



BURN OIL, GAS, OR BOTH

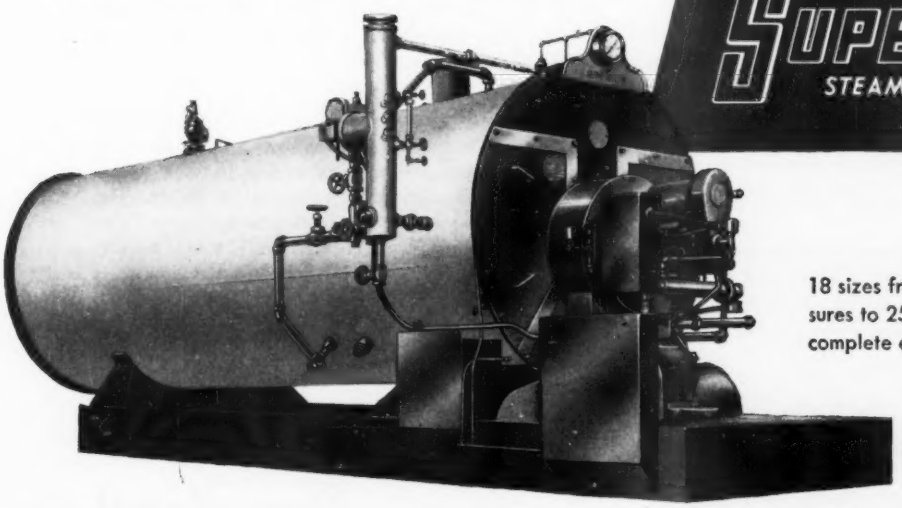
Superior Burners burn oil or gas or a combination of both ... changing from one fuel to the other in seconds.

Superior Steam Generators are the ideal choice for a new steam plant ... the simplest answer to expanding your present plant ... the easiest solution to replacing obsolete boilers.

Guaranteed to develop maximum rated capacities at thermal efficiencies in excess of 80%, their design embodies features which insure long-lived dependability and maximum fuel economy.

for performance you can **BANK** *on*

SUPERIOR
STEAM GENERATORS



18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 500.

SUPERIOR COMBUSTION INDUSTRIES INC. TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

George Edwards' Scrapbook

A salesman's call the other day reminded me of **this famous poem** *by V Schwab, President of Schwab & Beatty, Inc:*

I see that you've quite a big wad of dough
To tell me the things you think I should know.
How your plant is so big, so fine and so strong;
And your founder had whiskers so handsomely long.
So he started the business in old '92!
How tremendously int'resting that is . . . to you.
He built up the thing with the blood of his life?
(I'll run home like mad, tell that to my wife!)
Your machinery's modern and oh! so complete;
Your "rep" is so flawless; your workers so neat.
Your motto is "Quality" . . . capital "Q"—
No wonder I'm tired of "your" and of "you."
So tell me quick and tell me true
(Or else, my love, to hell with you!)
Less—"how this product came to be";
More—what the damn thing does for me!

Wish every salesman would paste this on the wall, right next to that photo of himself holding his biggest fish. Then he might remember that I won't be one of his catch unless he uses the right bait.

, , ,

Last time I was in New York, Ben Skrotzki on POWER told me turbine designers gazed into their crystal ball recently. What did they see? They said **a 400,000-kw steam turbine-generator** unit is just around the corner. I believe 300,000 kw is tops for size now.

That's an awful lot of power to be wrapped up in one package. But I still think it won't look bigger to me than the 500-kw job I started up and cut in when I got my first shift engineer's job at 19.

, , ,

I see where they **age tool steel quickly** now. Before precision grinding to 0.00005 in., they assure permanent accuracy of such gages by putting them through five separate heating-freezing cycles in fairly rapid succession. Temperatures range from plus 1300 F to minus 100 F. That process stabilizes metal in hours, preventing further "growth" that otherwise takes place during first two years in life of precision gages.

Wonder what old Sam Simcox would say about this if he were alive? Sam was the best tool designer and lathe hand I ever saw. He claimed he could measure a round shaft diameter and know its size within 0.001 in. with a hand caliper.

, , ,

Here is an engineer's sentence of 39 words, most of which are wasted:

"It is assumed ordinarily that in computations of this character it is desirable to arrange the various elements of the problem in the form of a tabulation in order to insure that avoidable errors are reduced to a minimum."

Why not say:

"Most engineers like to tabulate such data to reduce errors." From *Giving Power to Words,* by Philip W Swain, Editor of POWER.

If it's true that a picture is worth a thousand words, then it's also true that short sentences are better than long ones.

, , ,

It's hard to believe **natural gas,** piped throughout our country today, supplies five times as much energy as all our electric-generating plants. The first American gas line in 1821 was for street lighting in Fredonia, N. Y. Then in 1891, a 600-psi line was laid between Greentown, Ind. and Chicago, a distance of about 120 miles.

If you think 1821 an early date, the Chinese piped gas for fuel more than 2800 years ago. They used hollowed-out bamboo poles and piped gas to salt vats for evaporating brine.

George Edwards
Engineer

WATER WELL PRODUCTION TRIPLED BY DOWELL SERVICE

Chemical treatment removed retarding scale from equipment . . . reduced cost of water

A well drilled to a total depth of 205 feet into Niagara limestone had declined to 70 gallons of water per minute—a rate far below its capacity to produce. Needless to say, management was quite concerned about the increasing costs of its water.

Dowell Service was called in to survey the job. First tests showed the pump to be clogged badly with iron deposits. Other tests showed the entire well system to be fouled with the same material.

After a Dowell acidizing treatment, the well produced 230 gallons of water per minute—its original capacity! Management was so pleased with these results that a program of periodic maintenance treatments was instituted for *all* its water and waste disposal wells and auxiliary equipment.

How about your equipment? Is it delivering full capacity for you? If there's any question, call in Dowell for a free estimate. Dowell is equipped to provide chemical cleaning service—with special truck-mounted tanks, mixers, pumps to prepare and deliver necessary solvents . . . and experienced Dowell engineers to do the job for you.

For complete information on how Dowell Service can help solve your production and maintenance problems, call your nearest Dowell office or write to Dowell, Dept. F-23, Tulsa 1, Oklahoma.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

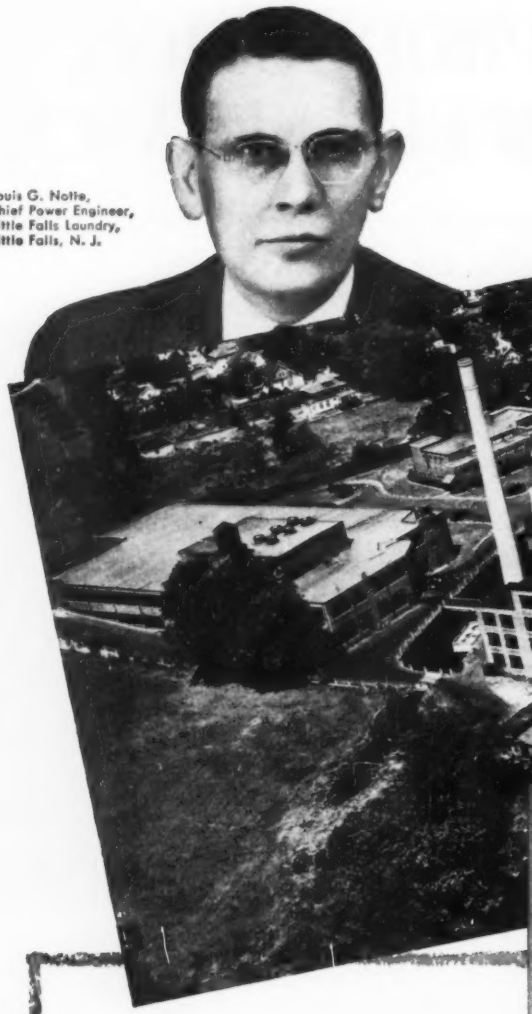
Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

"HOW WE USING COAL



Louis G. Notte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

To this great modern plant in Little Falls, N. J., 500 employees come every day to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers spread across a 5,000 square-mile area! The laundry can be called completely self-sufficient. It depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.

If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!

COAL in most places, is today's most economical fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

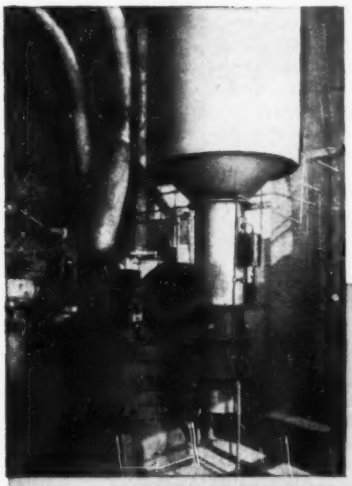
COAL is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

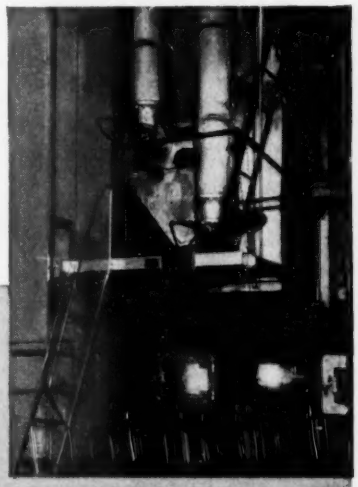
SAVE $20,000 A YEAR—INSTEAD OF OIL"

(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N.J.)

"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice —but so far we've *never* done it. Coal does a great job—cheaper."



This is the company's up-to-date pulverizer from which the ground coal is blown into the boiler. Before this final operation, the laundry employs a steel-slatted conveyor belt to feed a precrusher. From there, power-driven bucket-conveyors carry the coal to the 100-ton storage hopper which feeds the pulverizer. *Modern automatic coal devices of all kinds slash labor costs—make coal's basic economy even greater.*



This is a section of the laundry's modern coal-fired boiler installation. With modern equipment like this it is possible to add anywhere from 10% to 40% to the power derived from the same amount of coal in years past. Actually with coal-fired plants of up-to-date design many companies have brought over-all boiler efficiency up to 85% or more.

● Plants that use coal are in an enviable position —at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

To get *all* the great economy that coal can deliver—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis* . . . is your best fuel buy, by far!

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

Quik-Set

a NEW
INSULATING
FINISHING
CEMENT

- One coat insulates and finishes
- Super-adhesion; no wire mesh
- Least possible shrinkage; no cracks
- Smooth, white, extra-hard finish
- Sets quickly . . . in two hours
- Apply to flat or complex surfaces
- For temperatures up to 1800°F!
- Paint with water or oil base paints
- Apply Quik-Set now; permanently weathercoat anytime later!

Use this coupon today!

FORTY-EIGHT INSULATIONS, Inc.
Telephone: Aurora 9207
AURORA, ILLINOIS

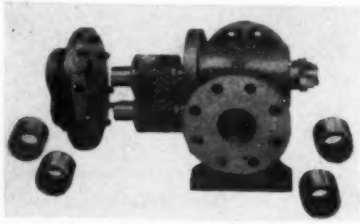
Send me full details on Quik-Set

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

More EQUIPMENT NEWS

Begins on page 156

ratings from 1 to 200 amps, and type T (slow), with ratings from 6 to 200 amps.
General Electric Co, Schenectady 5, N. Y.



Rotary Gear Pump

616 • *Hydrex* pump is designed primarily for positive displacement of lubricating liquids, will handle fluids and semi-fluids, 32 to 250,000 SSU. Capacities are 1 to 500 gpm at 300 psi for continuous duty or 500 psi for intermittent service.

Only two castings are used, for the body and the head, and there are only two moving parts, the two rotors. There are no inner races in the bearings and only one stuffing box.
Sier-Bath Gear & Pump Co, Inc, 9252 Hudson Blvd, North Bergen, N.J.

For more data on these items, use post cards p 165. Identify your request with item number.

Iodine Titration Reagent

603 • *Thiodene* is a dry, white organic substance that is permanently stable. It gives the advantage of a sharp blue end point for iodine titrations without the disadvantages of cooked starch. *Thiodene* requires no preparation for use, can be shaken directly from the bottle.

The new compound gives exactly the same end point as starch in all types of titration. Quantity used is not critical.
Magnus Chemical Co, Power Plant Service Div, Garwood, N.J.

Sewer Cleaner

608 • *Sewer Master* clears obstructions 100 ft or more from the sewer entrance. Cutting tools are attached to a coiled spring snake that is securely held and revolved at any convenient distance from the sewer entrance by revolving chuck jaws. Cutters

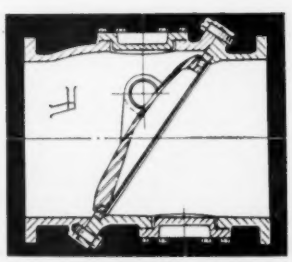
. . . here's how to get them out from under with

CHAPMAN *Tilting Disc* CHECK VALVES

Loosened pipe-joints are caused by hammering. And hammering is caused by valve-slam. But when a valve can't slam under usual piping arrangements . . . then you're free from the danger of line damage.

And this is all because of the Chapman Tilting Disc, with specially designed airfoil section that means light weight, and perfect balance in the open position, so it is easily held open in the flow . . . and then dropped quietly to a *cushioned closing* that does not even jar the line.

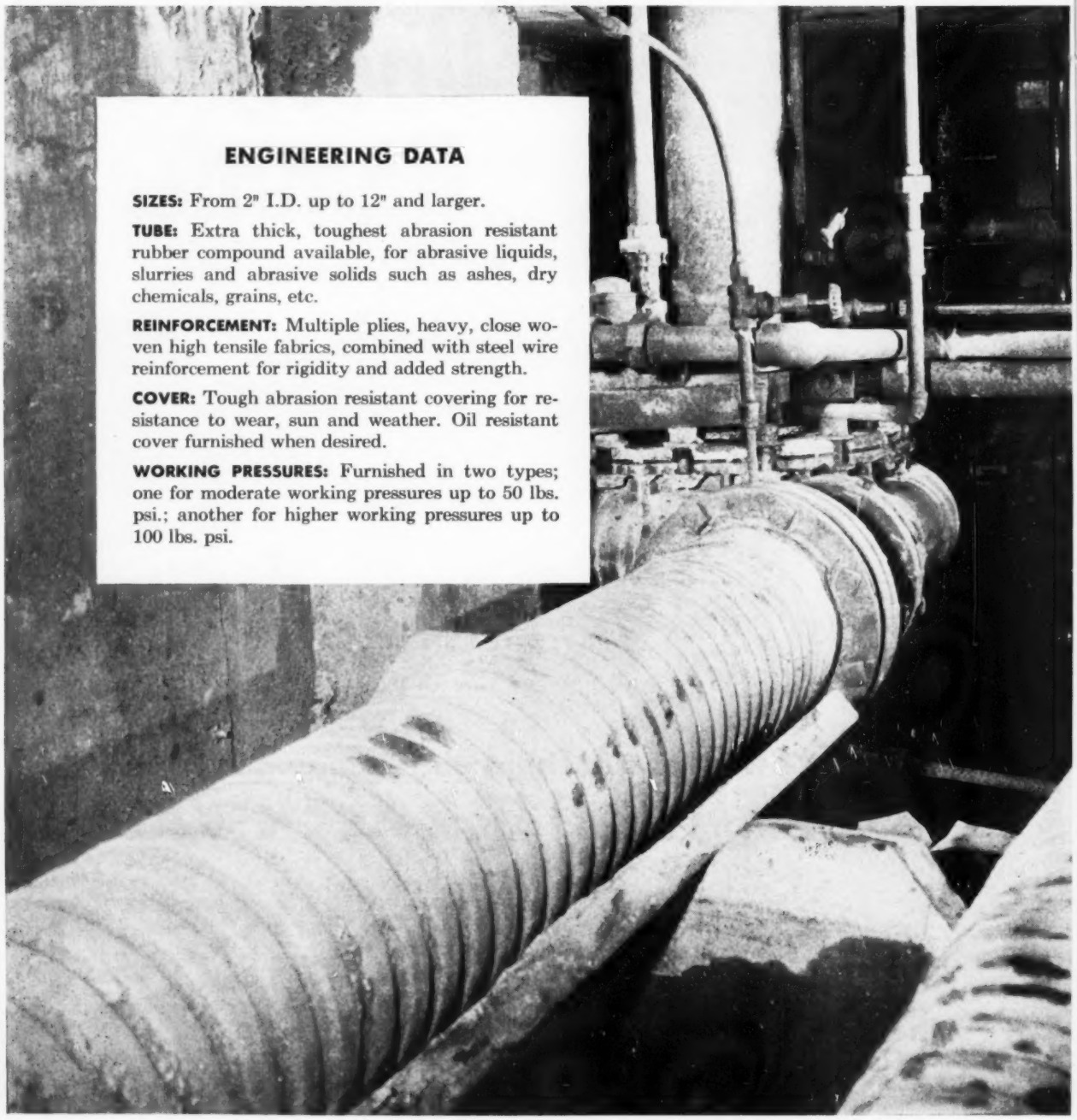
That's why certified tests from the country's top engineering schools and actual installations prove that Chapman Tilting Disc Check Valves reduce head-loss over regular swing-type checks. Check these tests for yourself . . . write for Catalog No. 30.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

Forecasts 5-Year Life



ENGINEERING DATA

SIZES: From 2" I.D. up to 12" and larger.

TUBE: Extra thick, toughest abrasion resistant rubber compound available, for abrasive liquids, slurries and abrasive solids such as ashes, dry chemicals, grains, etc.

REINFORCEMENT: Multiple plies, heavy, close woven high tensile fabrics, combined with steel wire reinforcement for rigidity and added strength.

COVER: Tough abrasion resistant covering for resistance to wear, sun and weather. Oil resistant cover furnished when desired.

WORKING PRESSURES: Furnished in two types; one for moderate working pressures up to 50 lbs. psi.; another for higher working pressures up to 100 lbs. psi.

HEWITT-ROBINS INCORPORATED

HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

in Slag Disposal Line

Customer's Performance Record

EQUIPMENT: Hewitt-Robins Flexible Rubber Pipe.

LOCATION: Philadelphia Electric Company, Richmond Generating Station, Philadelphia, Pennsylvania.

OPERATION: Disposal of slag and pyrites from two boilers in generating plant.

PERFORMANCE: The projected life of a test length of Flexible Rubber Pipe, originally installed in a line handling fly ash, was 8 to 10 years on straight runs and 5 to 6 years on bends—*double the life* of metal pipe in the same line.

Since the test length was installed the line has been changed considerably. It now handles highly abrasive pyrites and slag instead of fly ash, although the volume is the same. Based upon 3 years performance, the projected life of this new line, consisting entirely of Hewitt-Robins Flexible Rubber Pipe, is at least 5 years—a remarkable life expectancy, considering the extremely abrasive material being handled.

RESULTS: Hewitt-Robins Flexible Rubber Pipe is replacing existing metal pipe installations for this operation at other stations in the Philadelphia Electric Company.

CHECK FOR INFORMATION ABOUT THESE JOB-TESTED PRODUCTS FOR YOUR OPERATION

CONVEYORS:
- ☐ —Belt
- ☐ —Dock
- ☐ —Sectional
- ☐ —Vibrating

BELTING:
- *☐ —Elevator
- *☐ —General
- *☐ —Rayon
- ☐ —Woven Wire
- ☐ BUCKET ELEVATORS
- ☐ IDLERS

SCREEN CLOTH:
- ☐ —Electrically Heated
- ☐ —General
- ☐ VIBRATING SCREENS

HOSE:
- *☐ —Air
- *☐ —Fire
- *☐ —Flexible Rubber Pipe
- *☐ —Pinch Valve
- *☐ —Servall®
- *☐ —Steam
- *☐ —Twin-Weld®
- *☐ —Water
- ☐ MECHANICAL FEEDERS
- ☐ STACKERS
- ☐ CAR SHAKEOUTS

TRIPPERS:
- ☐ —General
- ☐ —Dust Seal
- ☐ BELT CLEANERS
- ☐ CRUSHERS
- ☐ STOCKING & RECLAIMING SYSTEMS
- ☐ DESIGN AND CONSTRUCTION OF COMPLETE MATERIALS HANDLING SYSTEMS

*For immediate information about these industrial rubber products, call your Hewitt Rubber Distributor (See "Rubber Products" Classified Phone Book.)

Hewitt-Robins Incorporated
666 Glenbrook Road
Stamford, Connecticut

NAME

TITLE & COMPANY

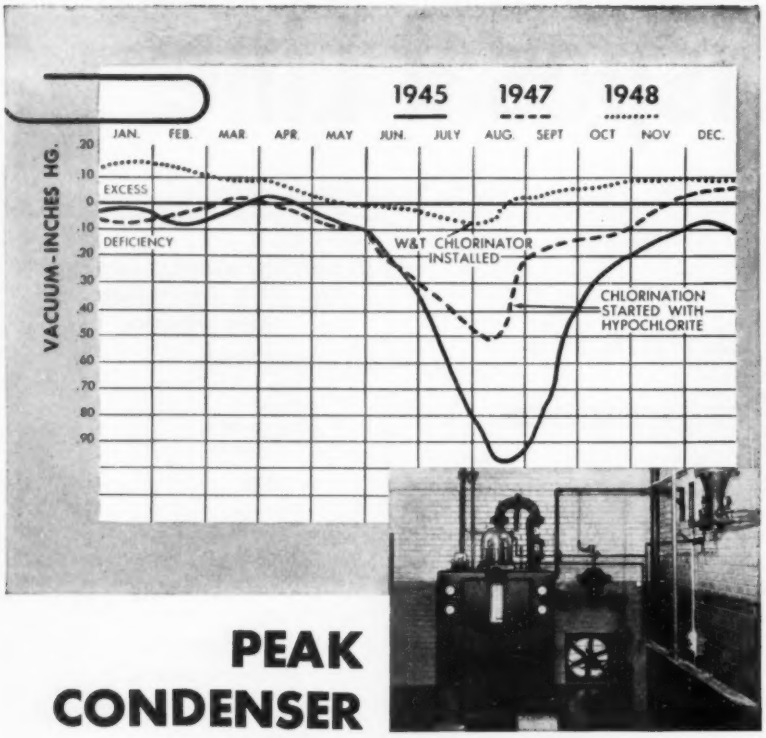
STREET ADDRESS

CITY PO ZONE STATE

770

INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • EXPORT DEPARTMENT: New York City.



PEAK CONDENSER PERFORMANCE...

... *with* W&T CHLORINATION

Condenser operating curves from the Greenidge Station of the New York State Electric and Gas Corporation, designed by Gilbert Associates, Inc., show clearly the effectiveness of slime control with chlorination and Wallace & Tiernan Equipment.

The 1945 curves record typical operation without chlorination—showing the serious drop in condenser vacuum during the warm water months. Early in 1947 chlorination was started by feeding hypochlorite, but not until August of that year was the dosage increased sufficiently to give appreciable slime control. Immediate improvement in condenser performance was evident.

The 1948 curve shows a full year of chlorination. The feeding of hypochlorite — although giving slime control — proved both expensive and difficult. To overcome these difficulties, a W&T Air Operated Master Chlorinator for feeding gaseous chlorine was installed in August 1948. Further improvement in performance was noticed as soon as the chlorinator was installed. After the installation, condenser vacuum even during the summer dropped only about 1/10 inch Hg. below "bogey" compared to a full inch loss during 1945.

You can put these benefits of Chlorination by W&T to work in your plant. Write today for additional information or to arrange a visit with your W&T Representative.

CD-38

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

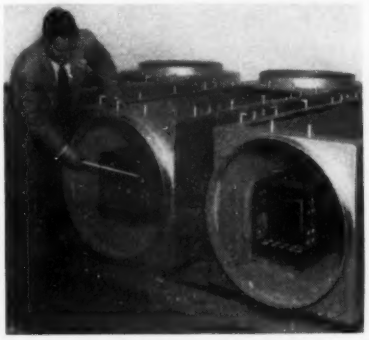
More EQUIPMENT NEWS

Begins on page 156

remove roots, grease, chips and other obstructions.

Snake can be revolved in either direction, and its motion is controlled by a lever. No. 420 *Sewer Master* weighs less than 100 lbs. Booklet available.

Oster Mfg Co, 2057 E 61st Place, Cleveland 3, Ohio



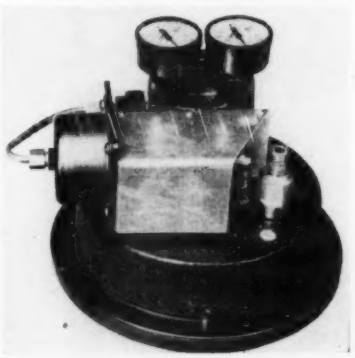
Isolated-Phase Bus Runs

607 • Metal-enclosed, isolated-phase bus runs are rated as high as 8000 amp, 14.4 kv, can be shipped in 3-phase packages with lengths to 16 ft. New units use aluminum conductors instead of the heavier copper conductors formerly used.

Electrical joints between aluminum conductor sections are silver surfaced by a plating process that insures a permanent low resistance joint, manufacturer claims.

General Electric Co, Schenectady 5, N.Y.

For more data on these items, use post cards p 155. Identify your request with item number.



Pneumatic Transmitter

630 • Instrument combines pressure gage with reliable pneumatic transmitter. Output pressure varies from 3-15 lbs (or 5-25 lbs if specified) regardless of range of pressure being measured. Instrument is calibrated with comparison of actual pressure applied to gage versus transmitted air.

Ranges from vacuum to 10,000 psig are available. Used with either recording or indicating instruments these units provide greater safety and convenience with high pressures, corrosive, toxic, inflammable or other hazardous fluids, and permit use of low pressure air piping to bring pressure

ALL FORGED STEEL

Edward

INSTRUMENT VALVES

Lowest Cost Valves for Their Rating!

Standardize on Edward instrument valves—forged steel, yet their price is comparable to ordinary bar-stock valves.

Edward instrument valves are top-quality in every design detail—easy-grip T-handle . . . bronze yoke bushing . . . forged steel one-piece outside screw yoke . . . forged steel corrosion-resistant EValized packing gland . . . EValloy 13% chromium stainless steel stem-disk with needle point for close flow control . . . forged steel EValized gland bolts that swing out of the way for easy repacking . . . heat resistant die molded EValpak packing.

And look at this versatility—

★ STEAM, WATER, OIL or GAS PRODUCT PROCESS LINES

Edward instrument valves fit into any piping system. Globe or angle, sizes ¼", ⅜", ½", ¾" and 1".

★ HIGH TEMPERATURES or HIGH PRESSURES

Rated up to 6000 lb at atmospheric temperatures, or up to 1500 lb at 1000 F.

★ STANDARD or CORROSIVE SERVICE

Available in carbon steel or 13% chromium bodies and trim.

★ TYPICAL USES

Orifice Meters	Regulators
Instrument Panels	Gage Lines
Oil Field Xmas Trees	Drip and Drain Lines
Hydraulic Systems	Pressure Recorders
Vent Lines	Corrosive Lines

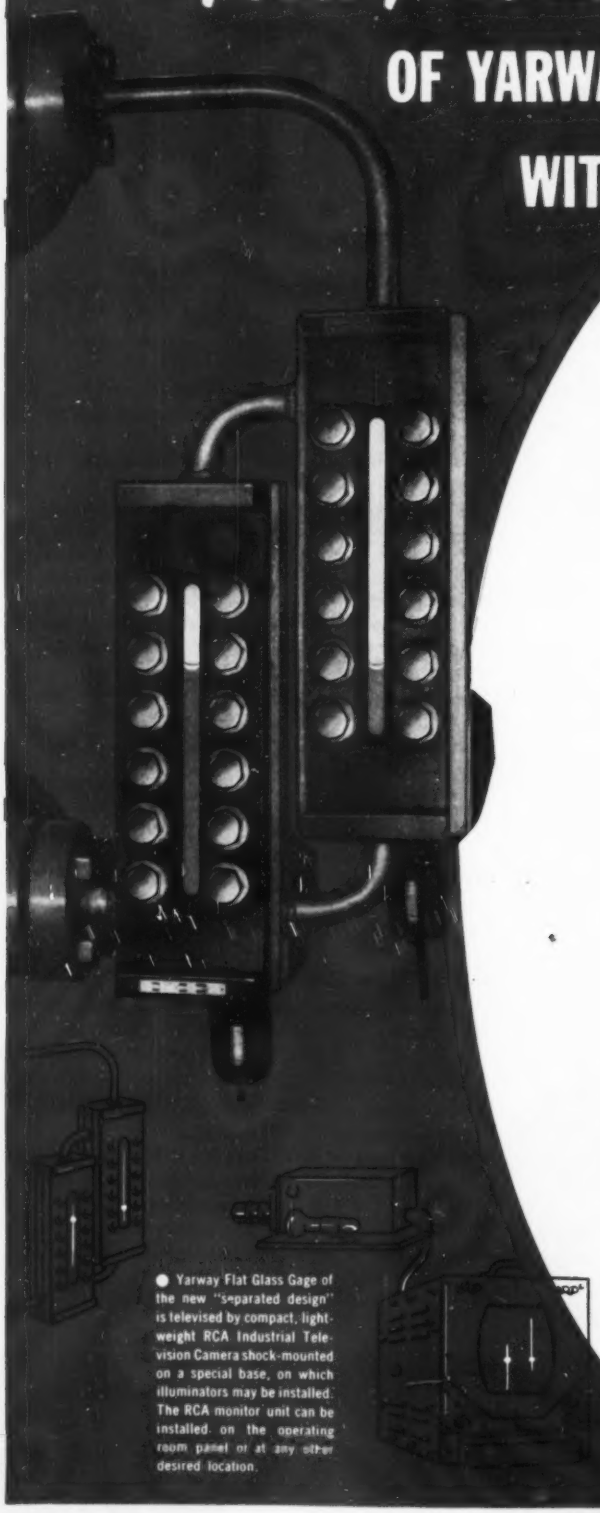
Get the full story on Edward instrument valves—*the lowest cost valves for their rating.* Write for Bulletin 491.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
1220 WEST 144TH ST. EAST CHICAGO, INDIANA

Another Product

Now Available... TELEVISION OF YARWAY FLAT GLASS GAGES WITH RCA INDUSTRIAL TV



● Yarway Flat Glass Gage of the new "separated design" is televised by compact, lightweight RCA Industrial Television Camera shock-mounted on a special base, on which illuminators may be installed. The RCA monitor unit can be installed on the operating room panel or at any other desired location.

RCA Industrial Television is now available for televising at a distance, boiler water level readings as indicated on Yarway Flat Glass Water Gages.

Yarway's broad experience in boiler water level indication, and RCA's leadership in the field of television, have been combined to give modern power plants "live" readings at any location in the plant.

This optional TV feature extends the already wide application of Yarway Gages in the steam power field. It is another of recent Yarway developments aimed at more accurate, more dependable, less costly water gage service.

Such features as the new *separated design with interconnecting expansion loops, Type "M" Illuminator* that causes the meniscus to shine like a star, the use of *tie-bar-type water columns, Yarway Welbond gage valves,* and *Yarway Pressure-sealed "floating assembly" gage glass inserts* make Yarway gages the modern gages for modern plants.

Your Yarway engineer will be glad to tell you about the new television feature, as well as the other Yarway advantages, or if you'd rather first have a descriptive bulletin, ask for Bulletin WG-1811-TV.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY®

RCA Industrial TV

PRECISION INSTRUMENTATION FOR THE POWER FIELD

For precise reproduction of remote readings—for easy viewing of operations that are now too difficult to watch—RCA introduces sharp-focus, high-definition industrial television.

The RCA Vidicon camera tube packs a maximum of image resolution into its lightweight, heavy-duty TV chain. The Vidicon tube—only 6" long by 1" in diameter—operates on the same scanning principal as commercial television—provides a clear, crisp picture that you can trust for accuracy.

FITS ANYWHERE—OPERATES ANYWHERE

Because of its small size—because there are only two units in a complete RCA Industrial TV chain—RCA Industrial TV can be used practically anywhere.

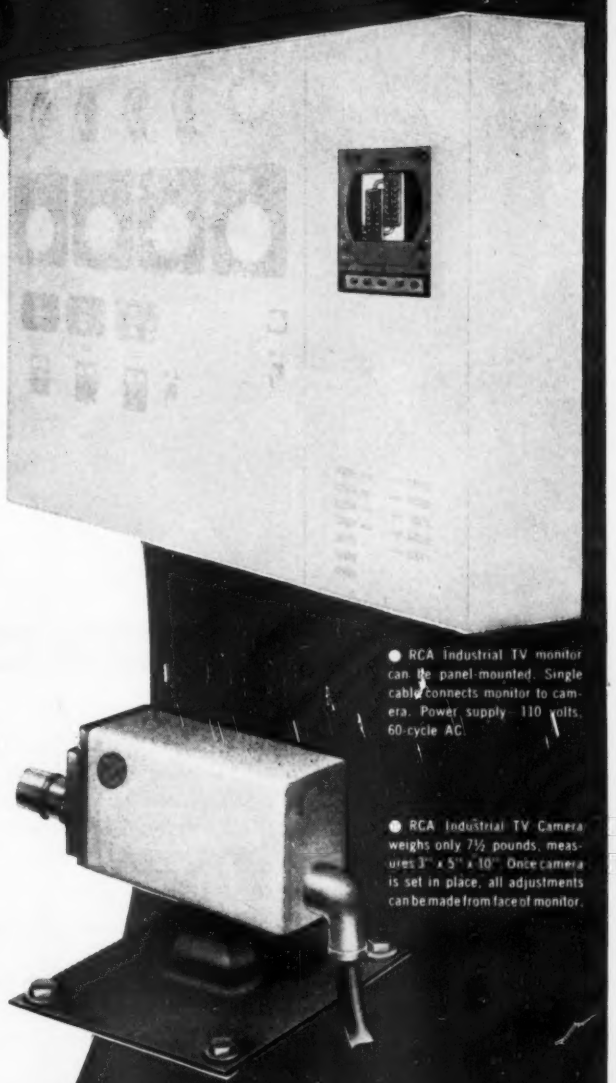
Typical power applications for RCA Industrial Television include: remote viewing of water level gages and meters; observation of internal furnace conditions; and smoke control.

- The following field-tested accessories—

Furnace water-cooled lenses	Outdoor weather-proofed housings
Automatic iris control	Remote panning
Shock-proof mounts	Industrial auxiliary viewers

—make RCA Industrial TV practicable indoors or outdoors in high or low ambient temperatures.

FOR INFORMATION write RCA Engineering Products Dept., Camden, New Jersey.



● RCA Industrial TV monitor can be panel-mounted. Single cable connects monitor to camera. Power supply—110 volts, 60-cycle AC.

● RCA Industrial TV Camera weighs only 7½ pounds, measures 3" x 5" x 10". Once camera is set in place, all adjustments can be made from face of monitor.

Industrial Products

RADIO CORPOR[illegible] OF AMERICA

ENGINEERING PRODUCTS D[illegible]

In Canada: RCA VICTOR Company L[illegible]

How Tight? Drop Tight!

This True Ball Joint Makes the Difference

Spherically ground Dart seats say "no" to leaks as long as in service — and as often as piping is changed. Darts can be taken off the line and used elsewhere time and time again. That's economy! What's more, the tight seal comes easily without heavy wrenching or strain.

QUICK FACTS

- Two bronze seats provide top resistance to pitting and corrosion
- Heavy shoulders can withstand the strongest yanks of the wrench
- Nut and body of air-refined, high test malleable iron are practically indestructible
- Threads are full and clean-cut of hard metal to prevent stripping

Experience proves that the men who *buy* Darts, the men who *use* Darts and the men who *sell* Darts have "something special"!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston•New York•Pittsburgh•Rome, Ga.

DART UNIONS

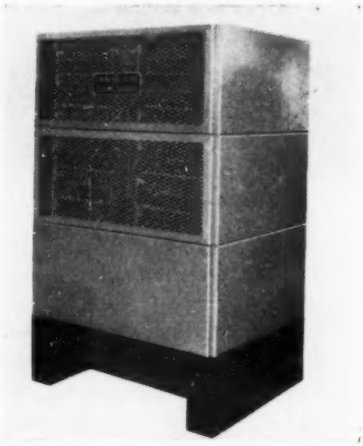
More EQUIPMENT NEWS

Begins on page 156

indication or recording to any part of the plant. Distances up to 1000 ft are practical.

Unit is suitable for panel, pedestal or wall mounting and is available in either 6 or 8½ in. size gages. Bulletin 780.

Penn Industrial Instrument Corp, 4110 Haverford Ave, Philadelphia 4, Pa.



Power Supplies

624 • New line of metallic rectifier power supplies for electroplating and anodizing operations is announced. Line includes manually controlled and automatically regulated units, as well as special equipment for barrel plating and precision laboratory work.

Dc ratings range from 500 amps at 6 v to 2000 amps at 48 v for manually and automatically regulated systems. Single control station controls entire output of the system regardless of the number of individual units. Manually controlled systems can be converted to automatic regulation. **General Electric Co, Schenectady 5, N.Y.**

For more data on these items, use post cards p 165. Identify your request with item number.

Universal Cleaning Spray

631 • *Spray White* removes grease, oil, wax, dirt, ink, dye, etc., with complete safety to metals, plastics, rubber, concrete, wood, according to manufacturer. Merely spray on and wipe off. Hard rubbing or scouring is seldom required, maker states. Spray gun is charged with

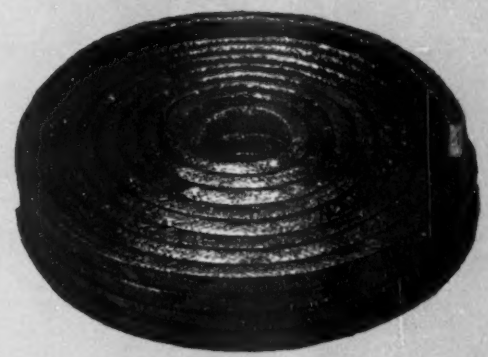
THE ANCHOR PACKING COMPANY

OFFERS

PLASTIC PACKINGS FOR MANY USES!

CARBONITE...COIL

INDUSTRY finds many uses for Style 808-C Cotton Jacket plastic Anchor packing, including centrifugal pump shafts, high or low speed; rotary rods or shafts; reciprocating rods and plungers; expansion joints; valve stems, and other applications against air, oil or water. It is unique in that it contains no wax or tar.



CARBONITE 808W (Ring and Spiral)

FOR FOOD PROCESSING APPARATUS, there is no better packing than this Anchor product. Style 808-W is a white mixture in which powdered mica has been substituted for flake graphite, making it suitable where graphite might be objectionable.

STYLE 8806-N.J. (No jacket) Ring, Spiral, is another flexible packing in which Anchor uses pure asbestos fiber and mica lubrication for food handling devices where graphite is not desired.

CARBONITE ANGULAR MOLDED RING

STYLE 808-Q is extensively used where conditions range as high as 1650 pounds of steam and temperatures run as high as 950° F. Meets exacting needs of turbine control valves, expansion joints, header valves and all high temperature, high pressure packing requirements.

BRANCHES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N. Y.
CINCINNATI, OHIO
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DAYTON, OHIO
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MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

These are but a few of the many Anchor Plastic Packings. For complete information we invite you to write today.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

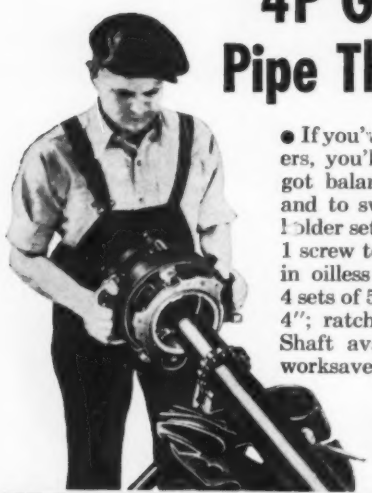
RIDGID means most service for your money!

No. 4P,
2½" to 4" pipe

Never before one so easy to carry—
easy to put on pipe...

RIDGID

4P Geared
Pipe Threader



● If you've rassled with old-style geared threaders, you'll go strong on this RIDGID 4P. It's got balanced loop handles—a cinch to carry and to swing onto pipe. Mistake-proof workholder sets to size before it's put on pipe—only 1 screw to tighten. Easy upkeep—drive pinion in oilless bronze bearing; safe enclosed gear. 4 sets of 5 high-speed steel dies, 2½", 3", 3½", 4"; ratchet handle. RIDGID Universal Drive Shaft available — also 4P for conduit. Buy worksaver 4P at your Supply House.

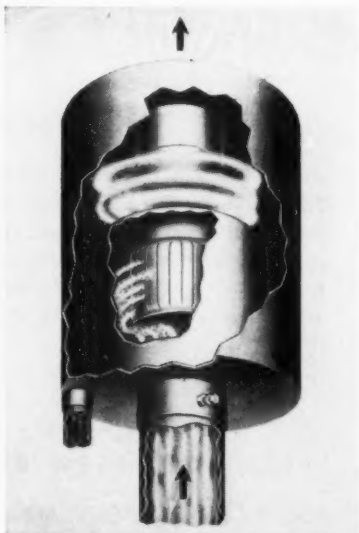
THE RIDGE TOOL COMPANY
ELYRIA, OHIO

RIDGID
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 156

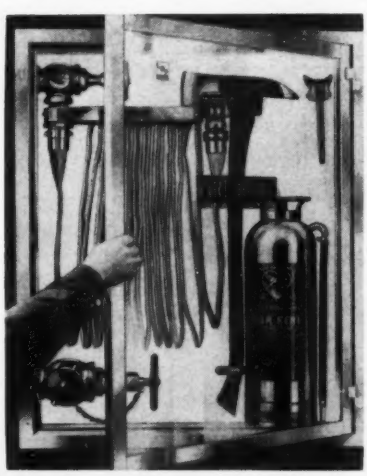
air pressure from any convenient source, can be refilled in a few seconds.
Kelite Products, Inc, 1250 N Main St, Los Angeles 12, Calif.



Exhaust Head

651 • New exhaust head for industrial stacks cleans up exhaust steam and vapors discharged to atmosphere. Unit has no moving parts or filters. Entrainment laden vapor goes through a stationary centrifugal element. Dirt particles, guck, oil and water are guided outward to walls of purifier, and ejected out the drain. Dry steam discharges to atmosphere. Manufacturer guarantees 99% efficiency.
V D Anderson Co, Dept EH, 1935 W 96th St, Cleveland 2, Ohio.

For more data on these items, use post cards, p 165. Identify your request with item number.



Fire Hose Cabinet

639 • New cabinet fits flush to the wall, puts entire contents on view. Ordinary installation includes angle valve, 75 ft of 1½

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered for tough service

THIS TUBE-TURN Welding Neck Flange will contain greater pressures under temperature extremes, and will last longer than other types under repeated bending or vibrations of piping. It is *engineered* for tough service . . . with a long, tapered hub, and a smooth transition in thickness to the pipe-end bevel.

You can select the exact Welding Flanges you require from TUBE TURN's complete line: welding neck; slip-on; lap joint; socket welding; blind; orifice; or pipeline non-standard flanges. It *pays to specify* TUBE-TURN Welding Fittings and Flanges. Call your nearby TUBE TURNS' Distributor . . . you'll find one in every principal city.

Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles • Denver • Atlanta

Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

ENGINEERING SERVICE

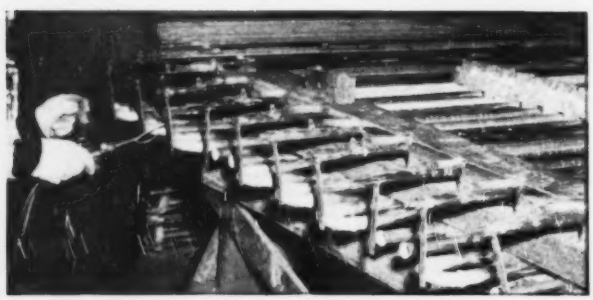
TUBE TURNS' *Engineering Service*
HELPS DEVELOP NEW PIPING TECHNIQUE

D. R. Cheyney, of TUBE TURNS' Engineering Service Division, has had wide experience in alloy and non-ferrous applications.

THIS STORY of how a large processor saved $50,000 and conserved scarce copper with a new approach to a piping application shows why TUBE TURNS, INC. is so highly regarded as an authority on piping engineering.

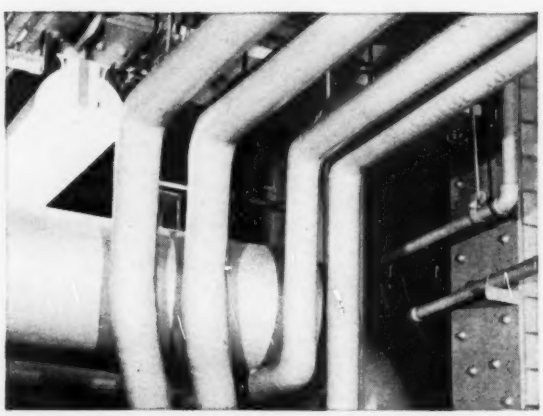
The problem involved the retubing of seven cooling units, formerly fabricated from copper tubing and fittings. Aluminum was considered as a replacement; however, there were no satisfactory methods for welding thin-walled aluminum tubing to welding fittings. TUBE TURNS' Engineering Service Division, working with Alcoa, came up with the solution. A new brazing technique was developed, and special TUBE-TURN Welding Returns, and TUBE-TURN Welding Elbows were supplied.

TUBE TURNS' Engineering Service is ready to help *you* in such special applications.



TUBE-TURN aluminum long-radius Welding Returns being brazed to aluminum tubing, in fabrication of cooling coils.

SPEEDS FABRICATION—TUBE-TURN Welding Fittings have won a reputation for dimensional accuracy that pays off in fast, easy alignment and fabrication. Time often is saved by welding assemblies in the shop, quickly tying them into the job.



SPACE SAVER—Welded piping makes a compact, neat installation—and requires no maintenance. Streamlined, its insulation is more easily applied.

Want Dimension Data?

TUBE TURNS, Inc. has compiled a handy folder of data covering dimensions and weights of TUBE-TURN Welding Fittings and Flanges. If you'd like a free copy just send this coupon.

TUBE TURNS, INC., Dept. C-6
224 East Broadway, Louisville 1, Kentucky

Your name .....

Position .....

Company .....

Nature of Business .....

Address .....

City ..... *State* .....

DISTRICT OFFICES

New York	Houston
Philadelphia	Tulsa
Pittsburgh	San Francisco
Chicago	Los Angeles
Atlanta	Denver

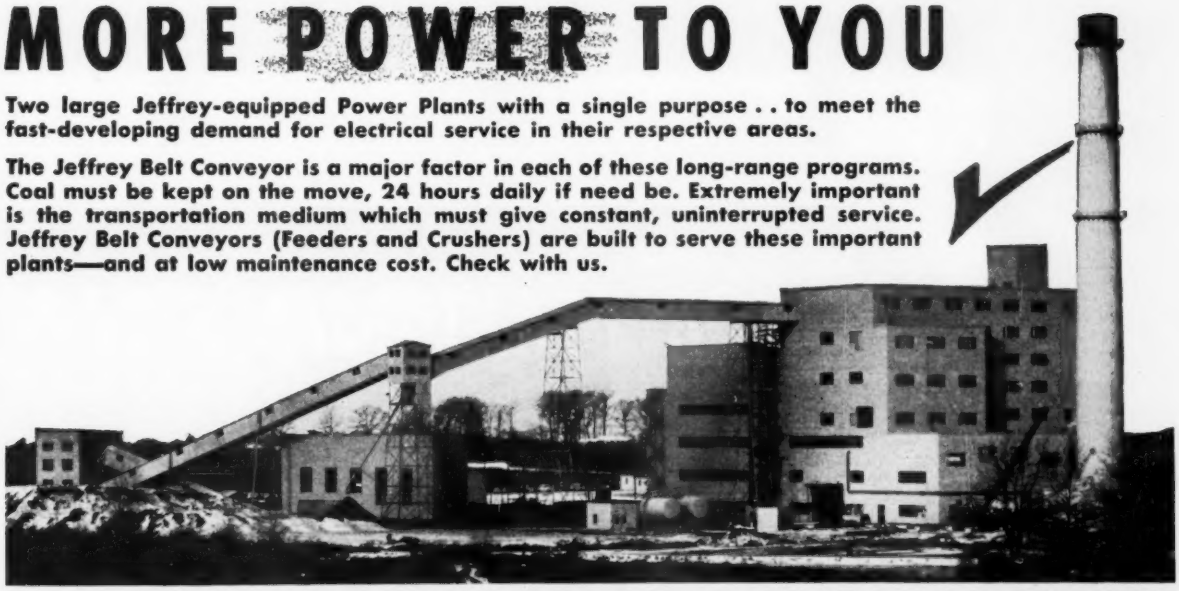
"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

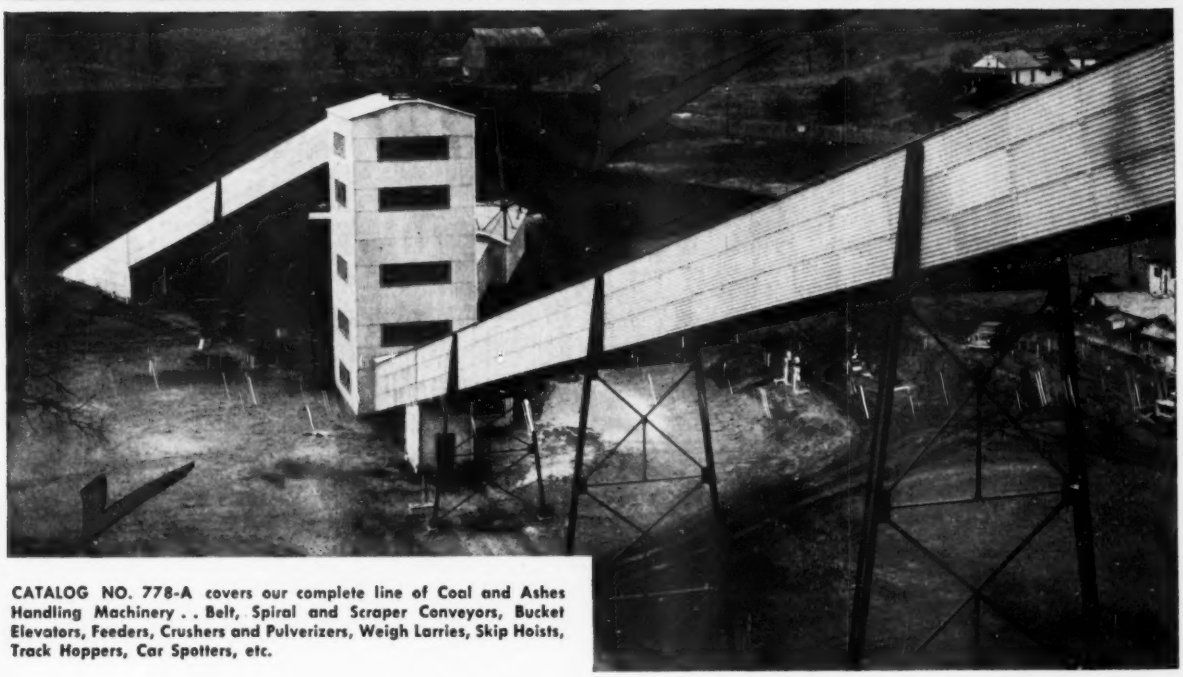
TUBE TURNS, INC.
LOUISVILLE 1, KENTUCKY

MORE POWER TO YOU

Two large Jeffrey-equipped Power Plants with a single purpose . . to meet the fast-developing demand for electrical service in their respective areas.

The Jeffrey Belt Conveyor is a major factor in each of these long-range programs. Coal must be kept on the move, 24 hours daily if need be. Extremely important is the transportation medium which must give constant, uninterrupted service. Jeffrey Belt Conveyors (Feeders and Crushers) are built to serve these important plants—and at low maintenance cost. Check with us.





CATALOG NO. 778-A covers our complete line of Coal and Ashes Handling Machinery . . Belt, Spiral and Scraper Conveyors, Bucket Elevators, Feeders, Crushers and Pulverizers, Weigh Larries, Skip Hoists, Track Hoppers, Car Spotters, etc.

JM **THE JEFFREY MANUFACTURING CO.**

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED
. . .IT'S A JOB FOR JEFFREY!

FOR MAXIMUM STEAM

there is a

HAGAN

Ring Balance Meter

for every type of service

A single Hagan Ring Balance Meter can measure one or two differentials to 420" WC at static pressures up to 3,000 psig, or differentials to 140" WC up to 15,000 psig. Automatic correction can be applied for such variable factors as fluid temperature, pressure or density. Indicating, recording and integrating features are standard. Flows may be added, subtracted or controlled in a manually adjustable ratio. Pneumatic signal transmitters are standard.

HAGAN
HALL
BUROMIN
CALGON

PRODUCTION EFFICIENCY

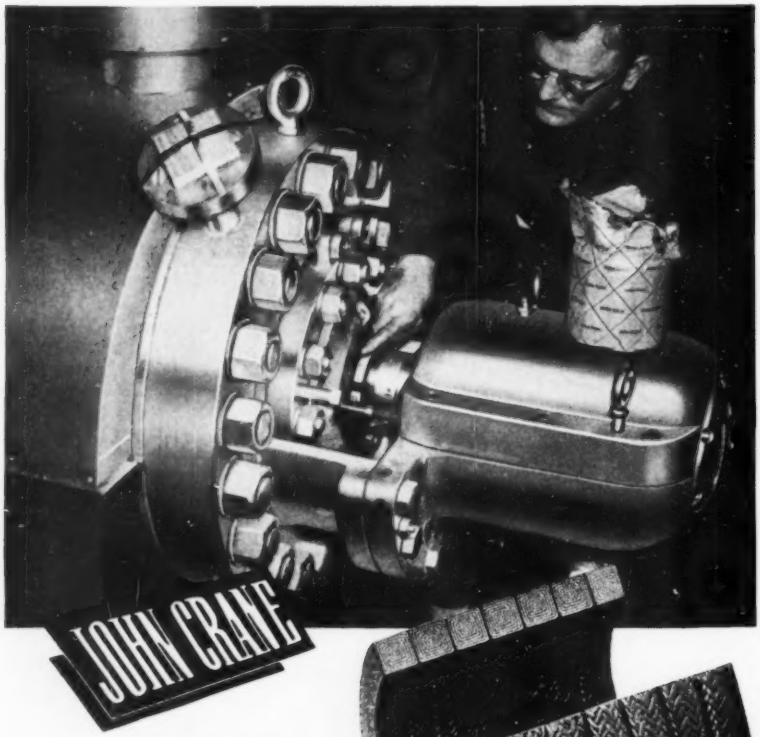
HAGAN
Automatic Combustion Control Systems
are "tailor-made"

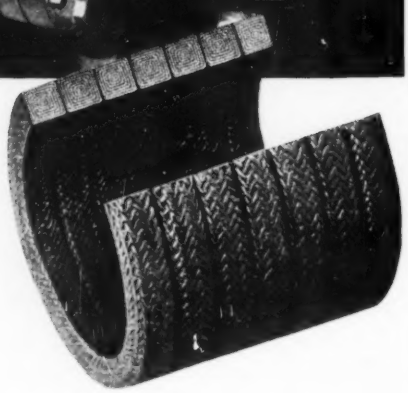
A system of Hagan Automatic Combustion Control can be supplied to suit exactly the requirements of your boiler plant. Every system is "tailor-made," from standard elements, for the number and size of boilers, steam pressure and temperature, and the fuel firing system involved.

Install HAGAN Controls and HAGAN Ring Balance Meters for versatility, durability, accuracy. Let our engineers show you what HAGAN can do.

HAGAN CORPORATION
HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Take a good look at this critical PACKING INSTALLATION...





Style 805-MBF Used On This 10-Stage High Pressure Boiler Feed Pump

This set of packings is going to handle a tough job. The pump is rated at 965 gpm, 4250′ total head, handling *hot* (312°F.) boiler feed water at 89# suction pressure and driven by a 3850 rpm induction motor (shaft sleeves are chrome plated—675 Brinell).

There are many styles of "John Crane" Packings—but Style 805-MBF was recommended and used because it was developed *and developed alone* for high speed centrifugal boiler feed pumps. The natural lubricating characteristics in the design of the monel and asbestos yarn braid-over-braid construction makes it a strong, wear resistant packing. Used in hundreds of installations all over the world—it has proved to be a highly efficient, long-life, trouble-free packing that gives you the results you want.

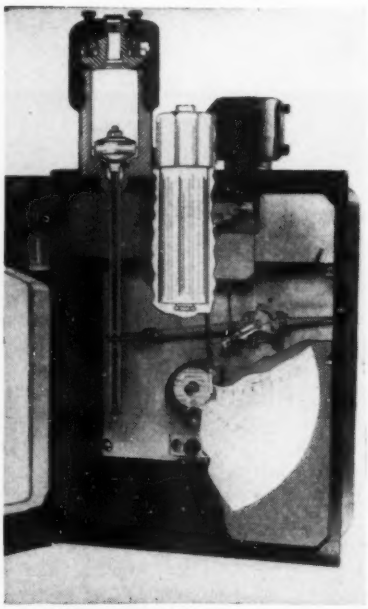
For quick action, let our Engineering Department help you. Write for latest "John Crane" Packings Catalog. Crane Packing Company, 1830 Cuyler Avenue, Chicago 13, Illinois.

JOHN CRANE CRANE PACKING COMPANY

More EQUIPMENT NEWS

Begins on page 156

in. hose, fire extinguisher, fireman's axe, spanner wrench. Standard sizes come in five widths and three heights.
Elkhart Brass Mfg Co, Inc, 1302 W Beardsley Ave, Elkhart, Ind.

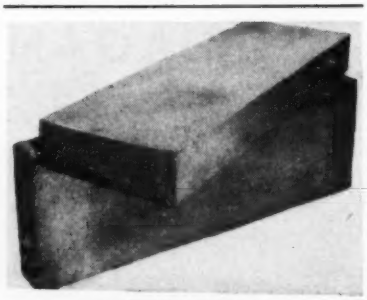


Mercury Manometer

622 • High-pressure mercury manometer is designed for routine operation at pressures up to 5000 psi. Features of the instrument include magnetic coupling between float and follow-up linkage, stainless steel float and range tubes, free-riding float to seal against upper or lower O-rings in float chamber, temperature compensation. Unit is also offered with a recorder that can be used with McGaughey-type continuous integrating mechanisms.

Float operates through a 2-in. linear travel in low pressure range tube. Range tubes are available for 100, 200 and 400 in. of water standard, or higher if specified. Stainless steel construction permits use directly with corrosive fluids.
Fischer & Porter Co, 10 Jacksonville Rd, Hatboro, Pa.

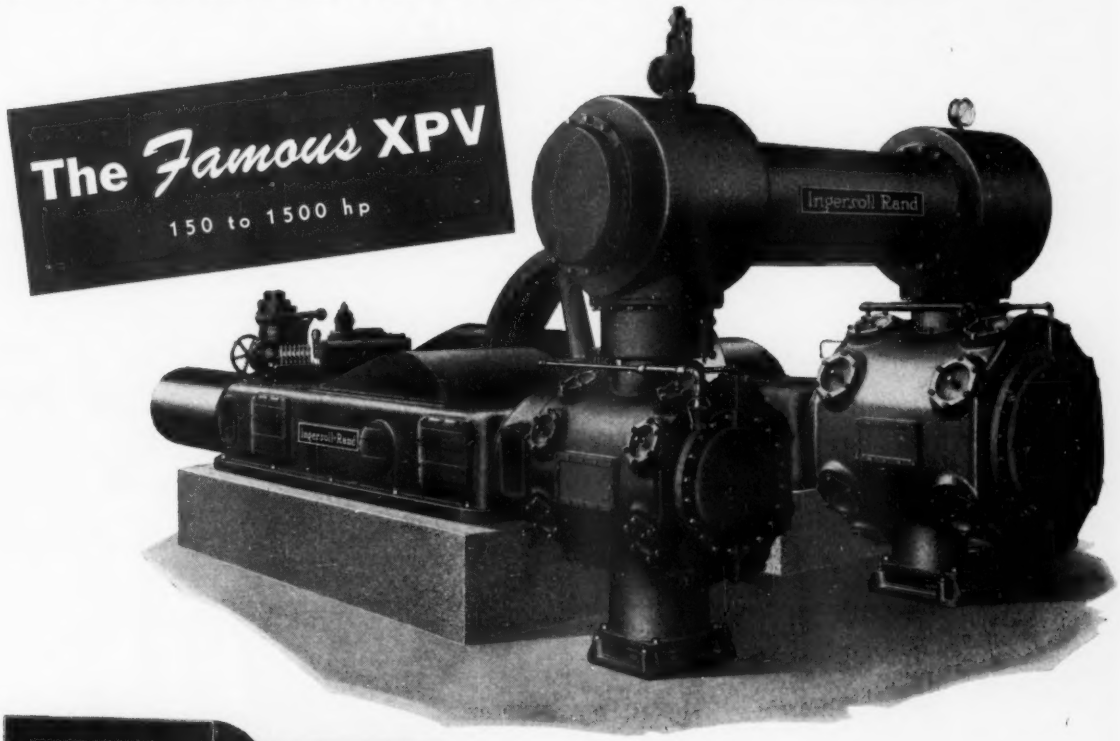
For more data on these items, use post cards, p 165. Identify your request with item number.

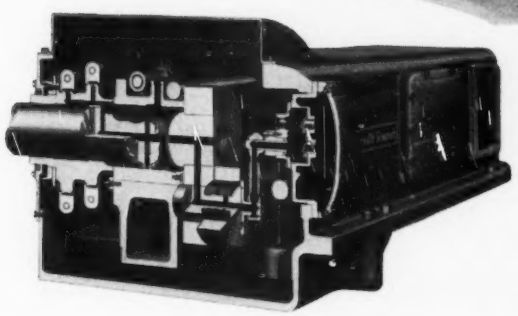


Insulating Blocks

632 • *Supertemp* pressure vacuum insulating blocks are suited for temperatures up

Sets the Standard for STEAM-POWERED COMPRESSORS





This cross-section through one of the main bearings of the new XPV shows its unique lubrication system. The combination oil-pump drive and distribution system (patented) supplies oil through drilled passages directly to the crankpin and main bearings, valve-gear eccentrics, and crossheads.

All of the oil discharged from the pump passes through a fine-mesh bronze filter before entering the distribution system. The oil stays clean and bearing surfaces are protected.

Because the frame is sealed, oil stays in; and dust and dirt stay out. The oil in the crankcase keeps clean, and the smooth contours of the frame make it easier to keep clean outside.

Ever since the first steam-powered compressor of "4-corner" construction was built by Ingersoll-Rand in 1900, I-R "steamers" have been the standard of comparison. Through the following years, other models introduced such precedent-breaking improvements as: balanced piston-valve riding cut-off steam end, double-crosshead and tie-rod construction, and Channel Compressor Valves.

The new XPV sets a truly new standard of comparison. Many of the outstanding features of the old XPV have been retained because of their advantages. Many improvements have been introduced to make a superior compressor.

One of the outstanding features of the new XPV is its full-floating bearings. Main, crankpin, and crosshead-pin bearings are all free to rotate; rubbing speeds are reduced, and bearing loads and lubricant are distributed evenly around the entire bearing surface both inside and out. The wear on these non-adjustable bearings is almost non-existent, and the sealed, dust-tight frame need be opened only for inspection.

Part by part, and as a complete unit, the new XPV has been designed to compress air or gas with the greatest over-all efficiency. For further information ask the nearest I-R branch office for Bulletin 3444-A. Call upon Ingersoll-Rand engineers to prove why you should use this new XPV, the new standard of comparison.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 578-1

If you want freedom from worry, install POWELL VALVES

Fig. 16003 W. E. 600-pound Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.

It may not be one of the "Four Freedoms" but freedom from worry is greatly to be desired. In flow control equipment you can have this freedom with Powell Valves—the valves with a record for long, dependable performance with minimum maintenance.

The Wm. Powell Company
Cincinnati 22, Ohio

POWELL

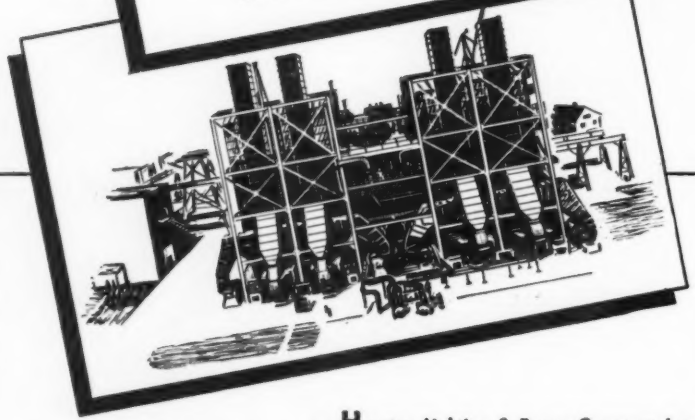
Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. When wide open, this design permits full, unobstructed flow through valve.

Fig. 3003 W. E.—300-pound Cast Steel Gate Valve with welding ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

Fig. 1314-A—1500-pound Steel Integral Bonnet "Y" Valve with socket weld ends. Sizes ⅛" to 2", inclusive. Globe and Angle Valves also available.

GO on GREEN

4 Green Forced Draft Fans
4 Green Induced Draft Fans
...Serve the West Junction Plant of
Houston Lighting & Power Company



Houston Lighting & Power Company is a leading factor in the power field of the great southwest. That it approved the selection of Green Draft Fans by the boiler manufacturer — in this case Riley Stoker — is evidence of high acceptance in the field. No utility can afford to operate with inferior or unsuitable equipment at *any* point. It must have equipment that is not only highly efficient but right.

To Houston Lighting & Power can be added other well-known recently completed utilities that are Green Fan plants, among them the following:

Central Hudson Gas & Electric Co.
Atlantic City Electric Co.
Virginia Electric & Power Co.
Monongahela Power Co.
Louisiana Power Light Co.
Kansas Gas & Electric Co.
El Paso Natural Gas Co.
Pacific Gas & Electric Co.
South Carolina Public Service Authority
Buffalo Niagara Electric Corp.

With utilities as with industrial power plants, it's safe to "Go on Green" when it comes to draft fans.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

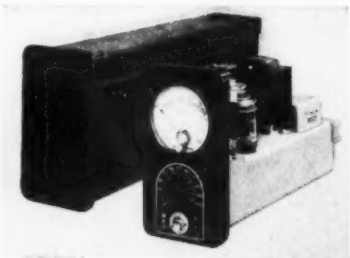
THE GREEN *Fuel Economizer* COMPANY INC.
BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

More EQUIPMENT NEWS

Begins on page 156

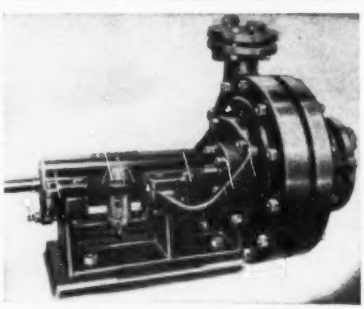
to 1900 F, and are reported to be better than ordinary mineral wool insulating blocks. Manufacturer claims blocks withstand higher temperatures, have greater breaking strength, and provide greater utility, are light in weight, easy to handle. **Eagle Pitcher Co, 900 American Bldg, Cincinnati 1, Ohio.**



Electronic Process Control

614 • New *American* system measures and controls temperature, pressure, differential pressure, liquid level and flow with virtually no lag in the transmission signal. All controllers can be installed in the control room regardless of distance from the process area. Control components are standardized to permit interchange at the panel regardless of the variable under control. **Manning, Maxwell & Moore, Inc, Stratford, Conn.**

For more data on these items, use post cards p 165. Identify your request with item number.



Plastic Centrifugal Pump

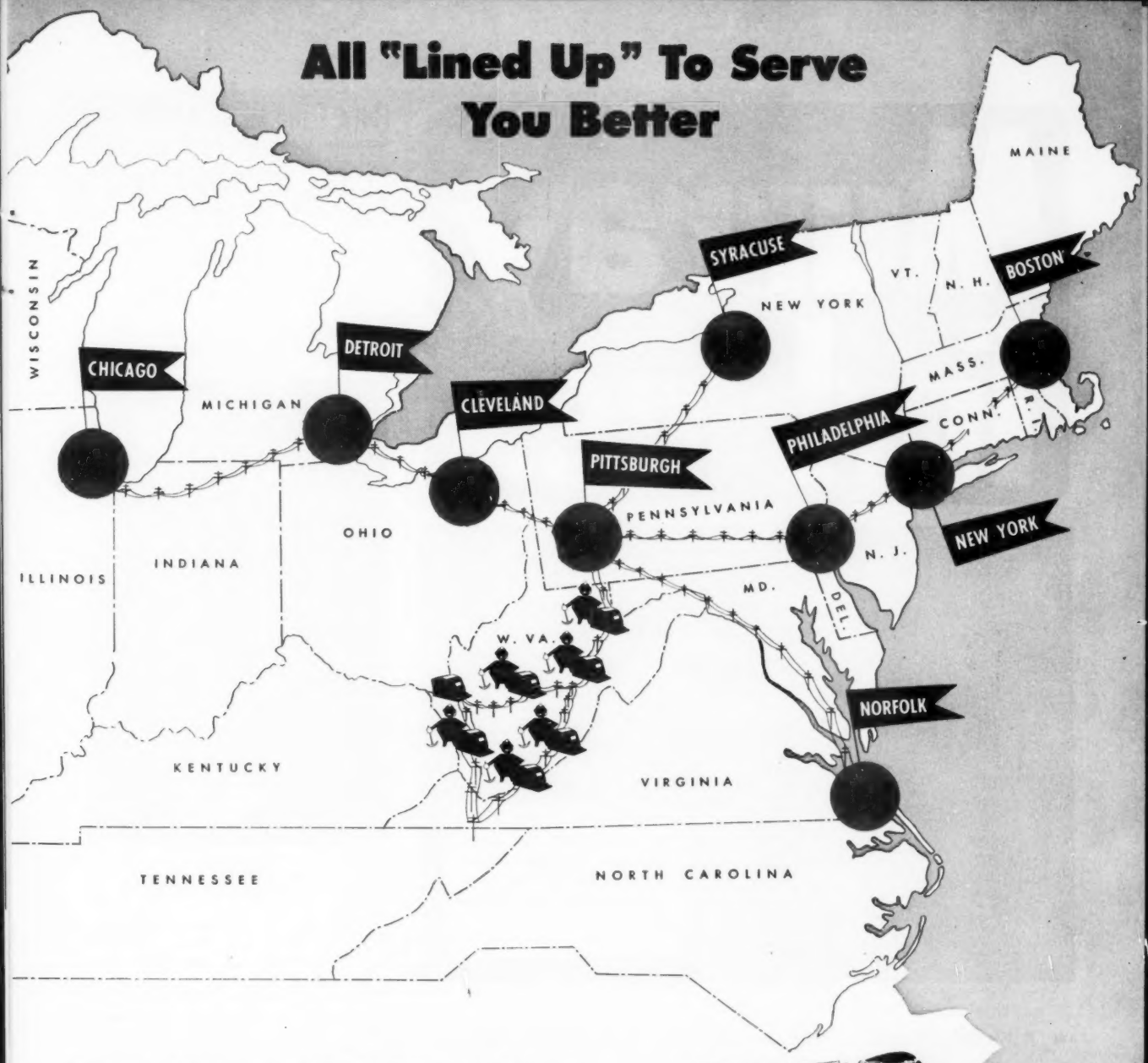
625 • Plastic pump handles acids, bases, salts, solvents, chemicals. Unit features solid plastic concentric casing and semi-open impeller. Long heavy bearing housing insures alignment, specially designed slinger and housing cap protects bearings from contamination. Fluid end parts are also made from corrosion-resistant plastic. Bearing housing can be replaced without disturbing pedestal alignment or casing.

Unit is made in 3 in. suction and 2 in. discharge size. At 1750 rpm it handles capacities to 300 gpm, heads to 110 ft. Bulletins CP-P 11-51A and CP-PH 1-52. **Mission Mfg Co, Centrifugal Pump Div, Houston, Tex.**

Flame Retardant Plastic

653 • Flame retardant laminated plastic with consistently low 60-cycle power factor has application for switchgear, control and

All "Lined Up" To Serve You Better



Here's *one* of the reasons why buying Beacon coal is almost like having a mine at your back door, so far as fast, efficient service is concerned.

Most of our mines, and all of our offices, are connected into a wide-spread Teletype network. Inquiries, expediting of orders, and information on shipments are all handled as promptly and completely as a local phone call. You get your answers quickly—and more important, you get your coal when, where and as you want it.

Beacon quality coals are exactly suited to individual applications . . . and Beacon service is exactly suited to your individual needs.

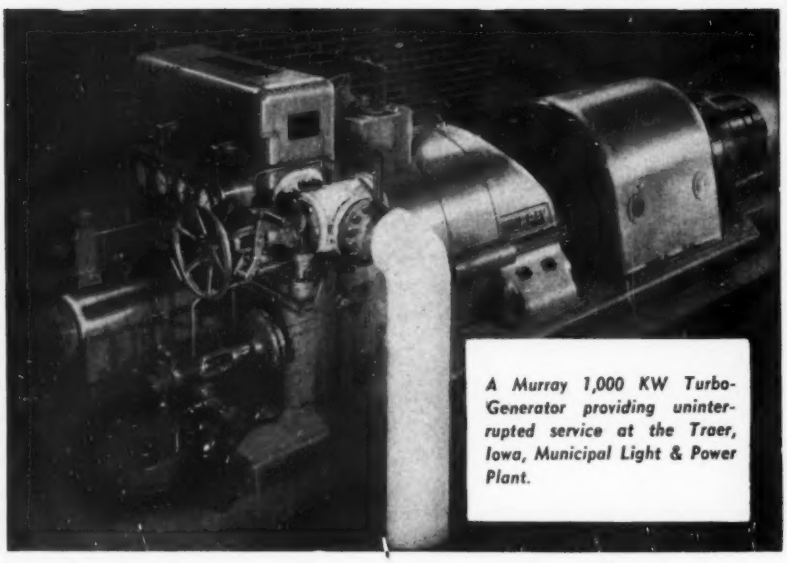
EASTERN GAS AND FUEL ASSOCIATES — BEACON COAL

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CHICAGO • CLEVELAND • DETROIT • NEW YORK
NORFOLK • PHILADELPHIA • SYRACUSE

For New England: **New England Coal & Coke Co.** ***For Export:*** **Castner, Curran & Bullitt, Inc.**

Murray Turbines



A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

● A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a *must*.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

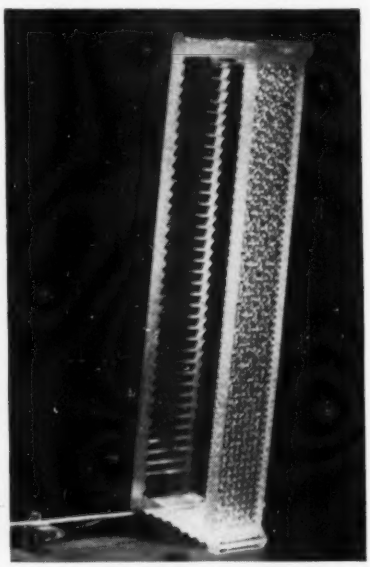
Builders of Steam Power Equipment for Three Quarters of a Century

More EQUIPMENT NEWS

Begins on page 156

other heavy electrical equipment where fire hazards exist. Designated GE 11537, laminate has good cold flow characteristics, low moisture absorption, good electrical properties to 125 C. It also is machinable, will burn only at elevated temperatures, and is self-extinguishable in one minute or less. Available in sheets from 0.010 to 2.0 in. thick.

General Electric Co, Chemical Div, 1 Plastics Ave, Pittsfield, Mass.



Skylight

633 • New skylight unit consists of two pieces of pressed glass hermetically sealed together with a sheet of *Fiberglas* between. Prisms on inside face limit and control amount of daylight and solar heat transmitted through the unit.

The *Toplite* sections are laid in aluminum grids, ready for installation. Advantages claimed include weather-proof construction, low solar heat transmission, elimination of glare, evenly diffused light, good insulation, etc.

Completed panels weigh 16 lb per sq ft, are made in 4 stock sizes: 3 x 3, 4 x 4, 4 x 5, and 3 x 6 ft. Because of their light-directing features, panels must be oriented approximately north and south for best performance.

Kimble Glass Co, Toledo 1, Ohio

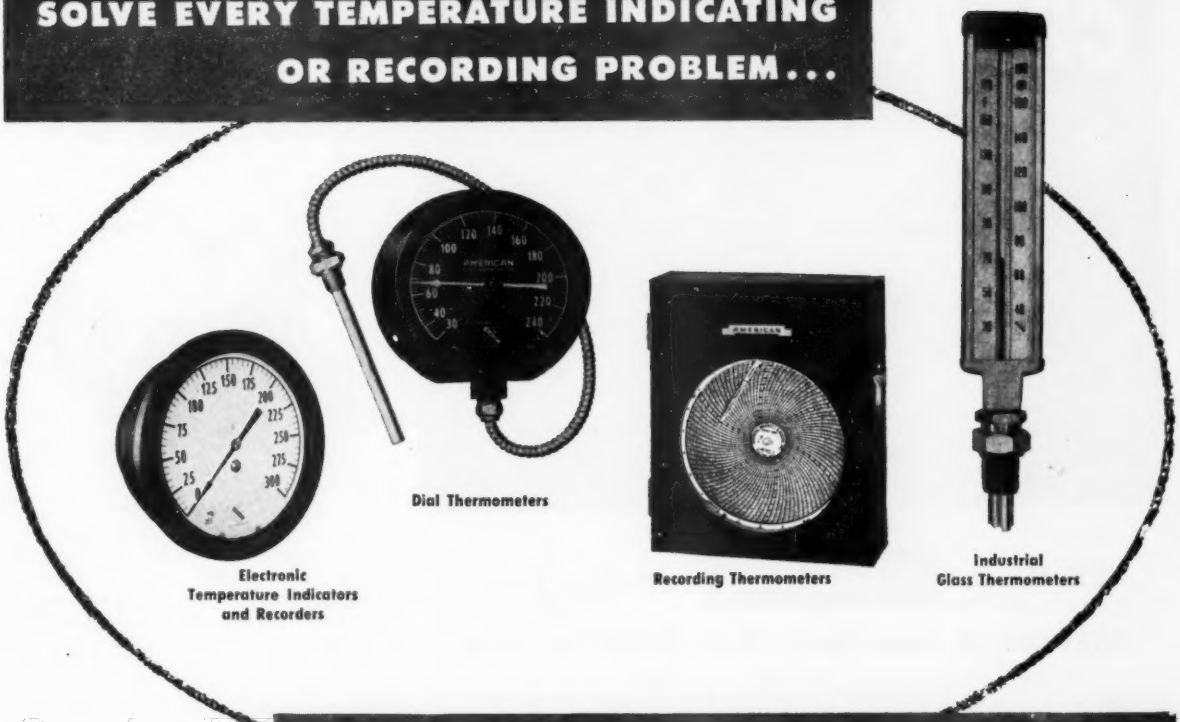
For more data on these items, use post cards p 165. Identify your request with item number.

Sewer Joint

654 • New ductile, chemical resistant sewer joint for joining vitrified clay pipe waste lines in the chemical process industry is announced.

Joint is precast on the job using a new hot-poured plastic composition called JC-60. Molds used on the bell and spigot section are designed so that considerable space remains at base of spigot and between these two precast components. When line is laid,

SOLVE EVERY TEMPERATURE INDICATING OR RECORDING PROBLEM...



Electronic Temperature Indicators and Recorders

Dial Thermometers

Recording Thermometers

Industrial Glass Thermometers

Specify AMERICAN THERMOMETERS

Maintenance of product quality . . . precise cost control . . . protection of equipment. For whatever reason consistently accurate temperature indication or recording is vital to your operations, choose the best -- American Thermometers and Temperature Measuring Instruments.

Unlimited application — determined by the type of instrument and requirements — is evident in the following broad specification information:

TEMPERATURE RANGES: Minus 100°F. to plus 3000°F.

TYPES OF ACTUATION: Mercury, vapor pressure, gas, bi-metal and thermocouple.

REMOTE INDICATION OR RECORDING: For measurements up to 250 feet from the temperature source, accurate mercury-actuated instruments are available with famous "Magic Pulse" self-compensating capillary tubing. To indicate or record process temperatures at one or more points a considerable distance from the temperature source, American Temperature Transmission Systems provide maximum accuracy.

Materials of the highest quality, advanced design, and precision workmanship assure perfect performance in the severest applications. The wide variety of types, temperature ranges, and means of actuation make it easy to select the proper American Thermometers and Temperature Measuring Instruments for your specific needs. Write for catalog.

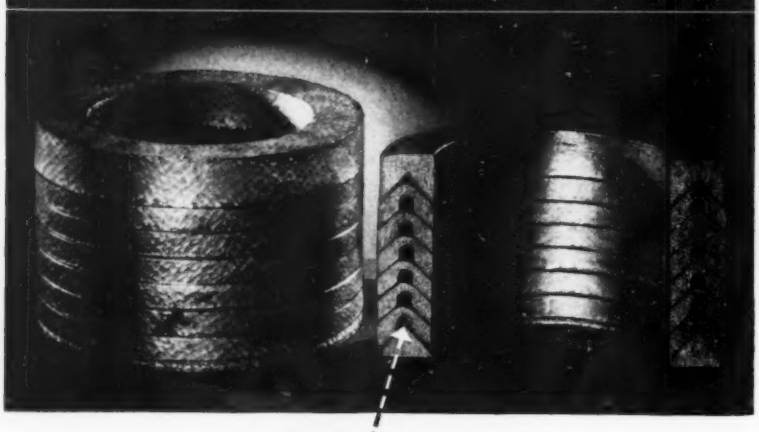
FOR THE BEST SERVICE, buy through your Industrial Supply Distributor. He has the experienced organization and carries adequate stocks to meet your most exacting requirements and at low cost.

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES,' CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

CHEVRON* PACKING



Exclusive hinge-like construction assures a positive, low-friction seal

At every pressure—from the lowest to the highest—Garlock CHEVRON packing provides a positive, low-friction seal. CHEVRON is ideally suited for use on hydraulic cylinders (both single-acting and double-acting), hydraulic rams, plungers of pumps and other reciprocating rods.

The exclusive hinge at the apex of each ring makes this packing flexible and sensitive to pressure changes. When the pressure is on, CHEVRON packing seals firmly both on the inside and outside edges. When the pressure is off, CHEVRON packing maintains a positive seal yet allows the ram or rod to return without binding. This automatic action not only prolongs the life of the packing but also increases the efficiency of the equipment on which it operates.

That is why many manufacturers of hydraulic cylinders, jacks, lifts and presses use Garlock CHEVRON packing exclusively.

Whether your job is plant maintenance or manufacturing new equipment, ask us about CHEVRON packing—the exclusive product of Garlock's own factories. Garlock CHEVRON packing is available in many materials such as: cotton duck with rubber or neoprene binder, asbestos with rubber or neoprene binder, hycar, "Teflon," and "Kel-F."

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

Branch Offices in Most Principal Cities

*Registered Trademark

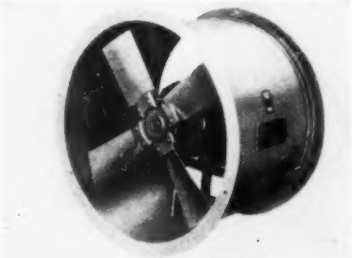
GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS, RUBBER EXPANSION JOINTS

More EQUIPMENT NEWS

Begins on page 156

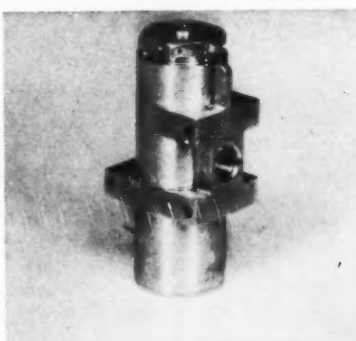
these spaces are filled with chemical resistant cold-setting cement called *Vitroplast.* Resulting plastic joint is both ductile and resistant to all common solvents, acids and other corrosives, manufacturer claims.
Atlas Mineral Products Co, 121 Norman St, Mertztown, Pa.



Direct-Drive Fan

630 • Type PLFX duct fan is built into steel drum with rear- and front-mounted flanges. Motor is ball bearing, totally enclosed. Blades are non-overloading, made of aluminum. Manufacturer recommends for temperatures to 110 F or higher on special order. Sizes 16 to 48 in., 2900 to 37,500 cfm. Bulletin 503.
Chelsea Fan & Blower Co, Inc, 639 South Ave, Plainfield, N.J.

For more data on these items, use post cards p 165. Identify your request with item number.



Pressure Relief Valve

629 • New pressure relief valve for low or high pressures has only one moving part, is light in weight. Unit will relieve and equalize excessive pressures of oil, water or chemicals to a predetermined setting. It protects pump by allowing flow through pump directly back to reservoir.

Unit is made in in-line envelope with either internal or external adjustments and locking, or side-port envelope with external adjustment and lock. Maximum free flow is equivalent to pipe size used.
Anco, Inc, One Baker St, Dept 35-B, Providence 5, R. I.

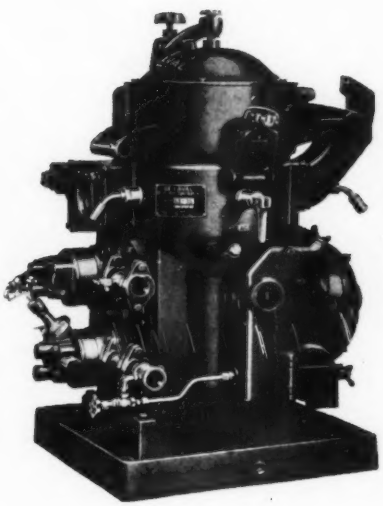
Conveyor Belt Fastener

655 • New design of drive-on conveyor belt fastener, the *Turtle* has one plate length with three teeth on each side, two

NO GETTING AROUND IT!

De Laval Constant Efficiency Bowl Gives You Better, Safer Purification

A De Laval Oil Purifier gets rid of ***both*** contaminants that ruin the usefulness of lubricating oil. The Purifier puts centrifugal force to work to throw out of the oil both solid impurities and water, and thus maintain the oil in a condition best compared with that of new oil.



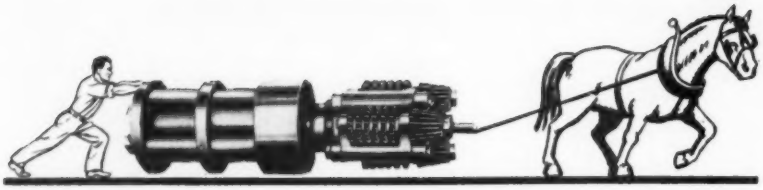
The manner in which purification takes place within a De Laval is important. The efficiency of purification is constant, from the moment a run starts until the bowl is full of dirt and must be stopped for cleaning. This "constant efficiency" is an inherent advantage of De Laval bowl design. Purification takes place between the discs, whereas dirt thrown out of the oil is stored outside of the zone in which purification takes place. Once it is centrifuged out of the oil, dirt can neither recontaminate the oil nor affect the degree of purification.

You can ***rely*** on De Laval constant efficiency purification.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

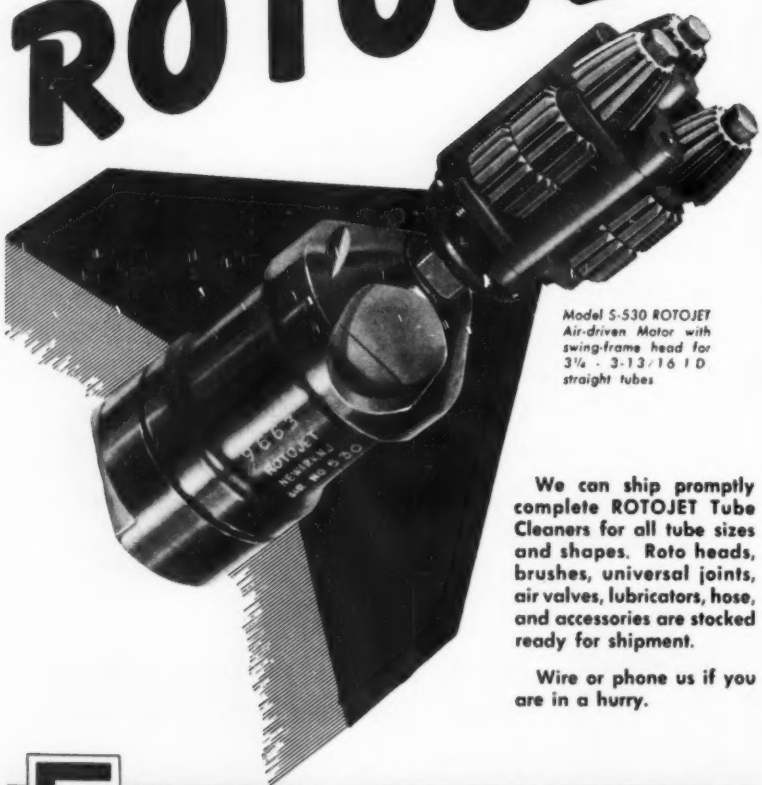
for more dependable power purification



Obsolete Tube Cleaners
waste time, labor, and money

Even if you rarely use tube cleaners, you can't afford to be without a powerful new ROTOJET. A ROTOJET should save you enough in time, labor, and air in one cleanout to pay for itself. You won't believe a tube cleaner can pack such tremendous power until you try the new ROTOJET.

Get a new **ROTOJET®**



Model S-530 ROTOJET Air-driven Motor with swing-frame head for 3¼ - 3-13/16 I D straight tubes

We can ship promptly complete ROTOJET Tube Cleaners for all tube sizes and shapes. Roto heads, brushes, universal joints, air valves, lubricators, hose, and accessories are stocked ready for shipment.

Wire or phone us if you are in a hurry.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

More EQUIPMENT NEWS

Begins on page 156

long and one short. This permits the minimum number of plates with maximum strength of joint. Available in steel, monel, stainless and everdur. A mechanic's hammer is all that is required to apply. No prepunched holes are necessary.

The *Turtle* is made for repairing rips in conveyor belts ⅜ to 9/16 in. thick and for joining medium duty belts 7/16 to 9/16 in. thick. Bulletin T-600.

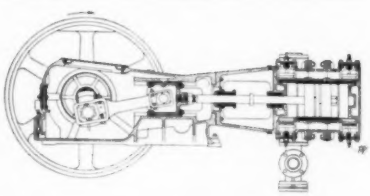
Flexible Steel Lacing Co, 4607 Lexington St, Chicago 44, Ill.

Automatic Safety Valve

656 • Automatic shut-off safety valve is quick-closing type normally held open by actuating head that operates like a standard sprinkler head. At specified temperature head opens and releases tension on spring. Valve closes in fraction of a second.

Unit is explosion proof. In case debris or blast knocks off head, valve will immediately close to prevent fire or secondary explosions. It will operate in any position. **Valco, Inc, 1410 West St, Cincinnati 15, Ohio.**

For more data on these items, use post cards p 165. Identify your request with item number.



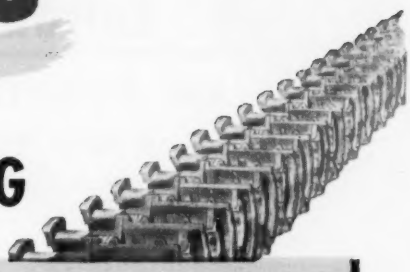
Oil-Free Compressor

621 • New compressor employs a steel-backed cylinder-liner of carbon. Manufacturer guarantees air or gas will be compressed free of impurities. Cylinder head in class ATL units is constructed in segments, permitting removal for inspection without interrupting intake or discharge connections. Bulletin 600.

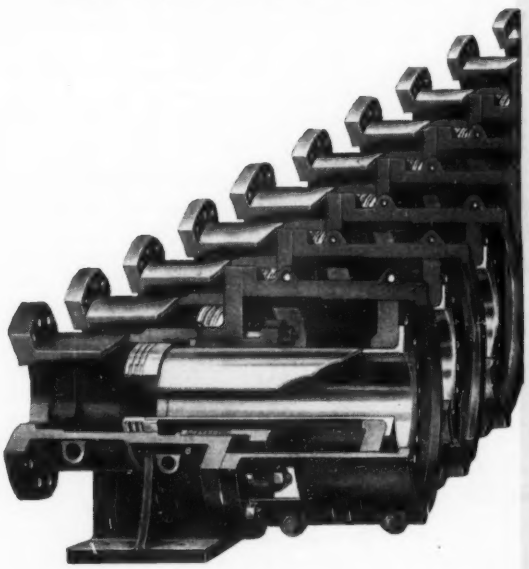
Pennsylvania Pump & Compressor Co, Easton, Pa.

6500 JOINTS

CAN'T BE WRONG

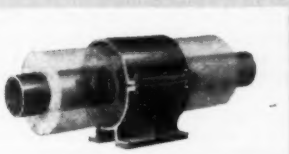


● You're sure to find the right one at **ADSCO**



No matter what expansion joint you need, look first among ADSCO's 6500 standard slip models. Manufacturing the world's most complete line of expansion joints, ADSCO is able to make a thorough analysis of your pipe expansion problems and to offer an impartial recommendation on the type of joint to use. Even if your problem is a unique one, remember that ADSCO has specialized since 1877 and can readily engineer a special joint to fit your needs.

King of ADSCO slip joints is the Piston-Ring, shown here. This exceptionally well-engineered and well-built joint carries the mark of ADSCO quality. Piston-ring feature permits it to be unpacked and repacked while maintaining full line pressure; thus service is not interrupted. Limit stops prevent over-travel of slip. Polished surface of slip cannot be scored because it is in contact with packing only. True alignment is assured by both internal and external guiding; split external guide permits smaller manholes. Full range of sizes, with 4", 8" and 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.



Use ADSCO Alignment Guides With ADSCO Expansion Joints

Don't let pipes get out of line. Use ADSCO Alignment Guides. Cylinder is 12" long in all sizes, permitting pipe movement of 10". Damage to insulation prevented by ample clearance between guiding cylinder and pipe.

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EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
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AMERICAN DISTRICT STEAM COMPANY, INC.

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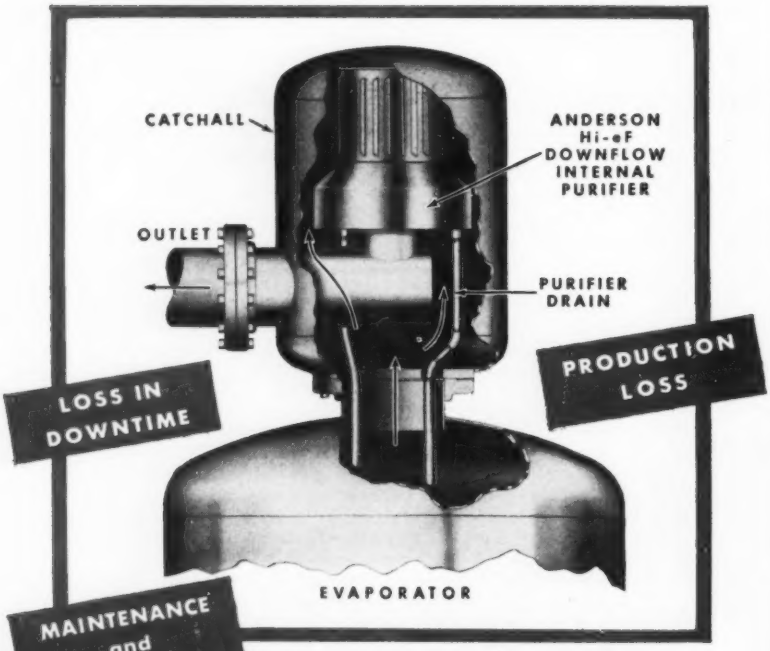
Since 1877

STOP

Entrainment Losses

IN EVAPORATORS STILLS AND TOWERS WITH Hi-eF Purifiers!



● Evaporators, stills, towers and similar vessels should have Anderson Hi-eF Purifiers. These money-saving units intercept and return to the evaporator all carryover thereby preventing possibility of loss of valuable products. In addition, by removing this carryover and entrainment, a Hi-eF Purifier eliminates frequent cleaning of vapor lines, condenser tubes and other equipment.

Hi-eF Purifiers cost no more than ordinary separators . . . yet are guaranteed 99% efficient in entrainment removal! These carefully engineered purifiers remove all carryover, solid particles and mist through carefully guided centrifugal action. Without moving parts or filters, Hi-eF Purifiers require no maintenance . . . never wear out. Let our engineering staff recommend the proper solution to your current problem. Mail coupon.

WATCHDOGS OF STEAM • AIR • GAS VAPOR PIPELINES AND EQUIPMENT

THE V. D. ANDERSON COMPANY
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Please send information on purifiers for evaporators, stills and towers.

Name ---------- Title ----------
Address ----------
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City ---------- State ----------

BY THE MAKERS OF SUPER-SILVERTOP STEAM TRAPS

More TECHNICAL BRIEFS

Begins on page 152

been built. The first 160,000-kva, 3600-rpm machine, at the time it was built, was the highest capacity that could be shipped under American railroad limitations of frame diameter, length and weight, with the armature factory-assembled in one piece.

Because of the better magnetic materials currently in use, particularly because of the employment of grain-oriented strip steel in the armature punchings, it is now possible to build and ship one-piece armature, 180,000-kva, 3600-rpm machines under the same shipping limitations which formerly restricted the size to 160,000 kva. The corresponding maximum-size, 1800-rpm machine for one-piece shipment is about 250,000 kva today, where prior to these improvements in the magnetic parts of machines that limit was about 200,000 kva. The authors then discuss other developments in the same vein. *APC Paper, no number.*

Present Status of Supercharged Cooling. *By W L Ringland and L T Rosenberg, Allis Chalmers Mfg Co.*

Ventilation of modern turbo-generators is the culmination of a long chain of developments extending over the past fifty years. The earliest small 4-pole steam-turbine-driven generators were quite short and were easily cooled from the ends. As ratings were increased and generators grew longer, means had to be devised to cool adequately the center. The multiple radial system introduced in 1924 was a major step forward. It brought the cool air into the stator core at many points around the outer diameter, and provided for its escape at intermediate positions. Long rotors were ventilated through trenches or tunnels below the rotor coils in addition to the heat transfer at their grooved surfaces. A radial scoop arrangement was also devised to draw air from the gap down into the rotor at many points. However, rotor temperature rise remained the predominant limiting factor in machine output.

Rotor ventilation was substantially improved in 1935 by the introduction of axial ventilating slots in the teeth and poles discharging into the air gap along the rotor length. This, in turn, stimulated further improvement in stator cooling, and in 1937 the first spirally ventilated stator was placed in operation. In this design every other vent duct along the length of the stator served as a gas inlet, while the intermediate ducts served as gas outlets.

Directions for ordering papers on p 154

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS

SPECTROGRAPHIC ANALYSIS
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

TO MARK PROGRESS

Ladish measures the spectrum to verify chemical composition

Metallurgical integrity—is safeguarded at Ladish by unsurpassed laboratory controls. Typical is this advanced electronic direct-reading spectrograph. On this unit as many as 300 determinations have been made in one hour to verify compliance of each mill heat with exacting Ladish specifications and, equally important, to assure the absence of detrimental "tramp" elements. Here is but one indication of the thorough, scientific procedures that assure reliability in every Ladish Controlled Quality fitting.

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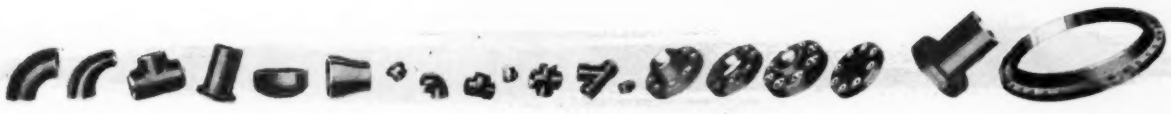
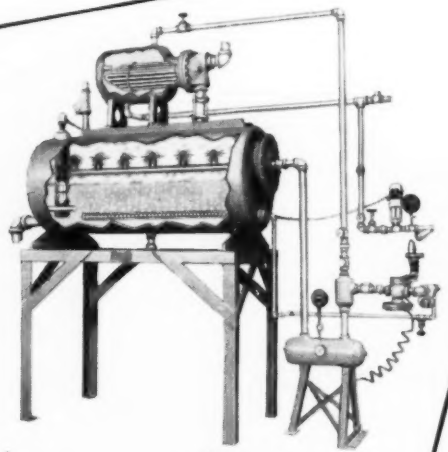
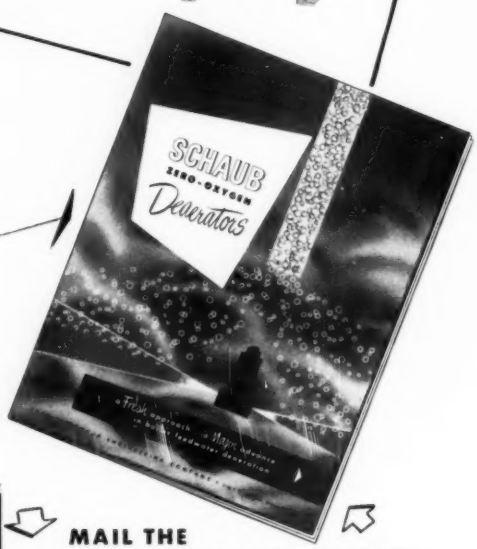


A FRESH LOOK INTO *Deaeration!*

SCHAUB ZERO-OXYGEN *Deaerators*





ENTIRELY NEW

in operating principle

in mechanical design

in the advantages they offer

"Newness" for its own sake is no advantage in a deaerator. But when new thinking achieves improved performance not possible with conventional designs, it's worth looking into!

The Schaub Zero-Oxygen Deaerator differs from all others in that it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold. The storage receiver itself is *fully vented* and operates at constant, safe atmospheric pressure.

This simple but basic difference opens the way to a whole series of better performance characteristics, including:

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WIDE RANGE FOR LOAD VARIATIONS
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The "hows" and "whys" of Schaub Zero-Oxygen Deaerators make an important story for any engineer or operating man concerned with boiler feedwater deaeration. Mail the coupon and we'll send it to you.

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Why a deaerating system? How can it save you money and trouble? What makes a good system? How to get maximum benefits at lowest cost? What are some of the engineering factors involved?

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"Heat Prover Completed a 30 Hour Burner Test In Just 6 Hours!"

Amazing Cities Service Heat Prover Works 5 Times As Fast As Old Method... More Accurate, Too!

Robert W. Pixler, Laboratory Supervisor for Eclipse Fuel Engineering Company, Rockford, Illinois writes:

"It did not seem possible that an instrument that is so fast and direct-reading could possibly have the accuracy we demand. But, we found the Heat Prover equally exact, possibly even more exact, than standard commercial testing equipment.

"Our test work with previous instruments was a long, drawn-out affair. But with the Heat Prover, we completed what would normally have been a 30-hour test in just 6 hours!...and we doubt that our old equipment could have maintained the accuracy delivered by Cities Service Heat Prover."

WHEREVER A FURNACE OPERATION IS INVOLVED, the Heat Prover can help increase productivity by providing:

- **Rapid, continuous sampling**
- **Simultaneous reading of oxygen and combustibles**
- **Direct measurement of oxygen and combustibles**
- **Easy portability**
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For details, contact nearest Cities Service office or write Cities Service Oil Company, Dept. F16, Sixty Wall Tower, New York City 5, N. Y.

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DO A **BIG JOB** IN A SMALL SPACE!

in a South American **DISTILLERY**

Two 44′ diameter Accelators treat 2800 gpm of Parana River water for clarification and color removal at a San Nicolas distillery in Buenos Aires. A portion of the treated water is used for boiler feed with supplementary treatment.

Elevated to provide gravity flow of clarified water to filters located over a clearwell, these Accelators provide water supply in a fraction of the space required by other types of water treating equipment.

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More TECHNICAL BRIEFS

Begins on page 152

This reduced the maximum stator temperatures by providing much more uniform ventilation than had been previously obtained.

When these improved ventilating techniques were combined with the advantages of high pressure hydrogen as a cooling medium, the most important single factor in both the stator and rotor temperature rise became the thermal drop through the insulation. Inasmuch as no substantial improvement in the thermal conductivity of insulation was foreseen, the next logical step was direct ventilation of the winding coppers within the insulation. This was successfully accomplished with the introduction of supercharged cooling in 1951.

The application of supercharged hydrogen cooling to high speed generators has added enormously to the economical utilization of raw materials in their manufacture. Fig 2. It conserves power plant space and affords the user other important economies in foundations, switchgear and bus structure supports.

Because of its favorable operation at elevated pressures, the supercharged machine is especially cool at its overload ratings. Its higher saturation improves its steady state stability and its shorter length makes accurate balancing easy and differential expansion far less serious.

The compressor has no wearing parts, is of heavy plate steel construction and requires no attention whatever. Bearings and seals are smaller, requiring less oil and less maintenance. And the quantity of gas required to fill the machine is greatly reduced. *APC Paper, no number.*

Operating Experience with Large Generating Units. *By P Liverside, Philadelphia Electric Co.*

Our experience has shown that the availability of the large turbo-generators is, for all practical purposes, essentially the same as for small units. An examination of the records on this subject revealed that for seven low-pressure 30,000 kw units covering forty-one turbine years, the availability was approximately 95.0 per cent. Correspondingly, for our four large units composed of three 182,000 kw and one 165,000 kw covering twenty-three turbine years, the availability was 93.6 per cent.

The 165,000 kw machine at Richmond Station, grand-daddy of large units, has now been in service for eighteen years. This machine was originally limited to 135,000 except through an emergency

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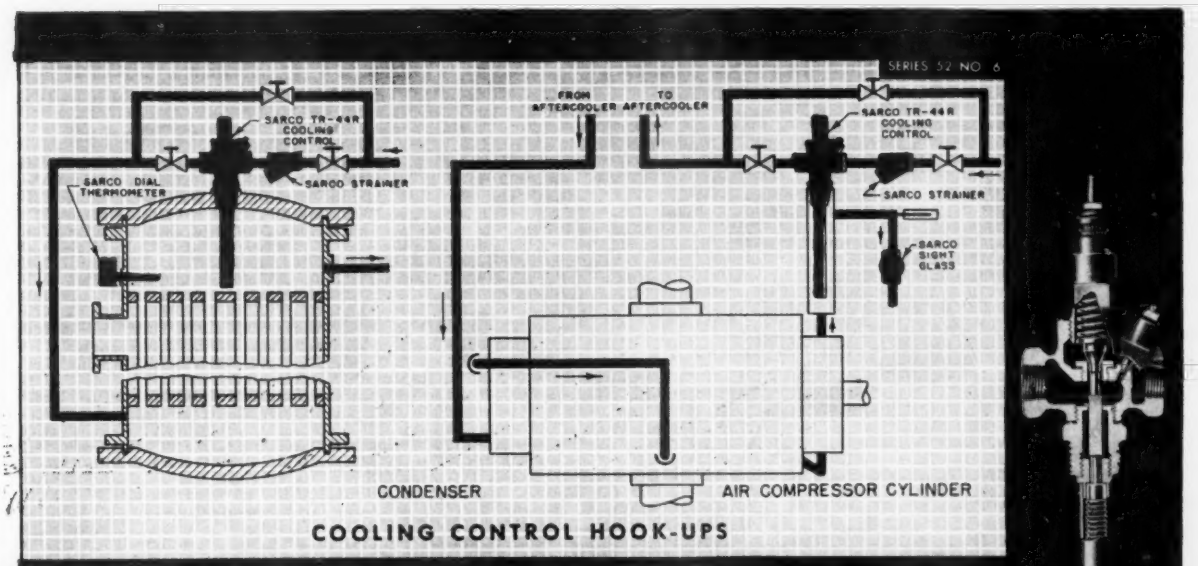
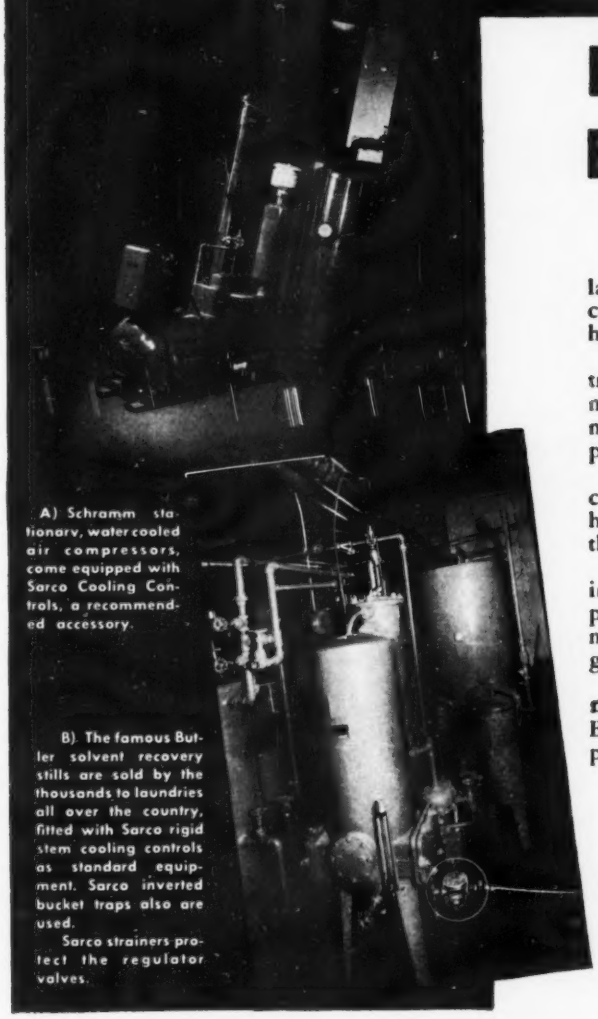


COOLING CONTROL HOOK-UPS

Trouble-Free *Cooling Controls*



A) Schramm stationary, water cooled air compressors, come equipped with Sarco Cooling Controls, a recommended accessory.

B) The famous Butler solvent recovery stills are sold by the thousands to laundries all over the country, fitted with Sarco rigid stem cooling controls as standard equipment. Sarco inverted bucket traps also are used.

Sarco strainers protect the regulator valves.

Endorsed by Equipment Manufacturers

Sarco dependable, self-operated temperature regulators with reverse acting valves regulate the flow of cooling water to air compressors, still condensers and heat exchangers in various industries.

Because of the low cost, sturdy construction and trouble-free operation of these liquid expansion instruments, many original equipment manufacturers sell their machines "Sarco equipped." This adds a valuable selling point, lifting their products out of the commonplace.

Sarco cooling controls, designed to meet the specifications of such equipment manufacturers may now be had by individual users at prices possible only because of this quantity production.

Sarco rigid stem cooling controls are now factory-installed by many manufacturers of stationary air compressors, solvent recovery stills, condensers, injection molding machines, hydraulic testing equipment, degreasers, lime slakers and many other types of equipment.

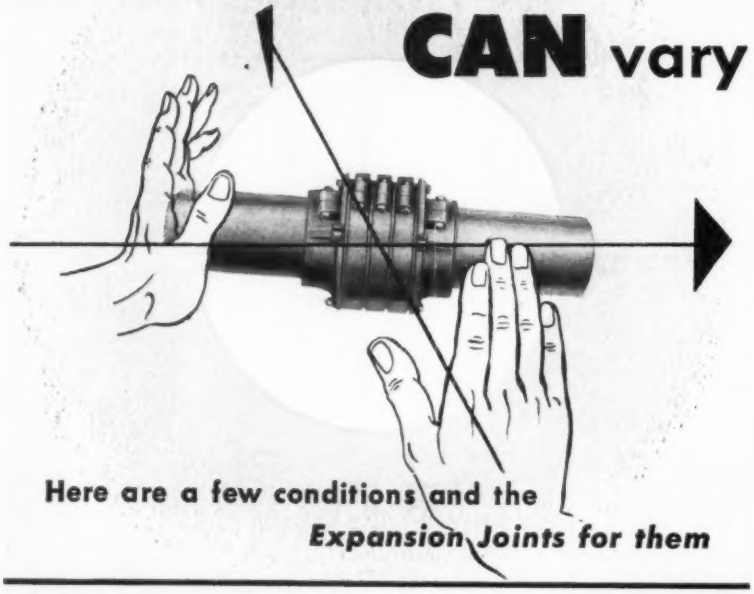
Write for Bulletin No. 700-14 for complete information. No obligation, of course! Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ontario.

SARCO

improves product quality and output

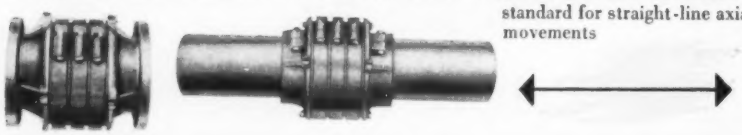
412

Pipe line movements CAN vary



Here are a few conditions and the *Expansion Joints for them*

BADGER DIRECTED-FLEXING SELF-EQUALIZING JOINTS

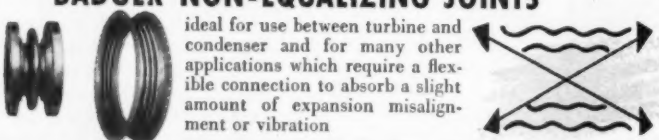


standard for straight-line axial movements

BADGER TANDEM JOINTS

for lateral or combined lateral-axial movements: designed individually for each problem

BADGER NON-EQUALIZING JOINTS



ideal for use between turbine and condenser and for many other applications which require a flexible connection to absorb a slight amount of expansion misalignment or vibration

BADGER HINGED TYPE JOINTS

Hinged type expansion joints are designed to absorb expansion in one plane by angular rotation. They must be used in pairs and are specially designed to meet individual applications. Available in both non-equalizing and self-equalizing types, either flanged or welded ends.

The above designs suggest the versatility of the Badger corrugated type of expansion joint . . . *the joint that requires no maintenance.* There are others equally useful. If you have *any* kind of problem like those outlined above or any other pipe line movement you must control and absorb, write us in detail. We shall be glad to submit recommendations.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

More TECHNICAL BRIEFS

Begins on page 152

tie. However, in 1949, permanent connections were made to two old boilers and the machine was rerated to its design capacity of 165,000. During this time it has produced over 16 billion kw hrs and has operated at an average capacity factor of opproximately 72 per cent. As a matter of interest, this unit in 1944—a war year—operated at a capacity factor of 90.74 per cent.

The maintenance record of this machine is one of outstanding accomplishment. Not until 1949, fourteen years after initial operation, was the high pressure end opened for inspection. Both the rotating and stationary blades were found to be in good condition. Considerable work was necessary on the horizontal joint and other parts of the casing. This major overhaul was completed with an outage time of sixteen weeks. During this time, the low pressure section has been inspected practically every year in order to properly maintain the blading in the later stages when water cutting occurs. These outages averaged not more than ten days apiece. It is also interesting to note that the machine operated on its original bogie throughout this entire period.

A running record from 1939 of the maintenance cost on all our generating units indicates that the cost per kwh for the 165,000 kw unit at Richmond Station is approximately 40 per cent less than the average of all the machines on the system. The average maintenance cost of the 182,000 kw Southwark machines installed in 1947 and 1948 to date has been 75 per cent less than for the system average. It is evident, therefore, that the unit cost in mills/kwh of maintaining large units is less than for small units.

The problem of scheduling maintenance on these large machines is one which requires careful study and planning. There are many factors to be considered in arranging these schedules such as a seasonal load drop, hydro availability, manpower availability, outage time required, etc. We find no penalty attached to the large machine in this respect.

One of the most important considerations in maintenance scheduling is the detailed planning to coordinate men and materials so as to reduce the outage time to an absolute minimum. When a machine is out of service, the replaced kwh must be generated on machines with lower efficiencies. The result is an out-of-pocket cost.

These costs, which are proportional to

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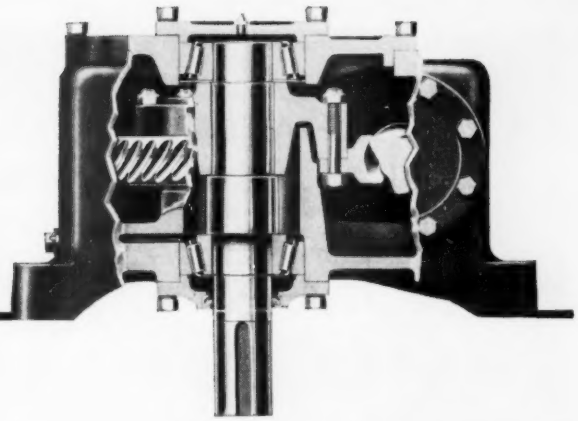
THE RIGHT DRIVE



. . . where Dependable Performance Counts

RIGHT

. . . because they are designed and built to insure efficient and reliable power transmission even under the most severe operating conditions.

Philadelphia
WORM GEAR SPEED REDUCERS

are of extremely sturdy construction throughout. Bearings have a generous spread, which in the vertical units as shown here, provide for heavy radial loads. Note, too, the famous dry-well construction which eliminates oil leaks down the vertical shaft, and these are but a few of the outstanding features found in Philadelphia units.

Vertical type reducers can be furnished with output shafts extended either up or down. Conventional horizontal types can also be supplied. A complete range of ratios from 3½:1 up to 6300:1, in units up to 250 horsepower, provide complete selectivity.

For full information on Philadelphia Worm Gear Speed Reducers, write for catalog WG-51.

Philadelphia Gear Works, INC.

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

A TALL STATEMENT that can give you FAT SAVINGS on WATER SOFTENING:

Nalcite HCR®
(DOWEX*)
offers three times the softening capacity of non-resinous exchangers.

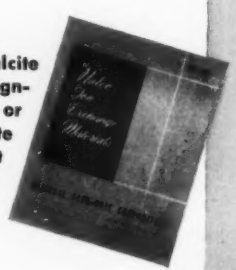
TALL as it may seem, this statement has been proved in every case where Nalcite HCR has replaced non-resinous zeolites. Many cases, in fact, show four times greater capacity for Nalcite HCR.

In water treatment, higher capacity means greater efficiency and greater economy. Higher capacity means more soft water at lower regenerant cost. Higher capacity means longer softener runs, less danger of hardness leakage.

Physically and chemically stable Nalcite HCR, pound for pound of regenerant, offers greater softening capacity than any other cation exchanger available today. Ask us about it.

TECHNICAL HELP ON WATER SOFTENING PROBLEMS

Nalco Bulletin 58 gives basic information on Nalcite HCR, designed to be of sound assistance in designing new softening plants, rebuilding old ones, or simply converting existing facilities for Nalcite HCR high performance. Your copy will be sent free upon request.



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A Nalco® PRODUCT • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

More TECHNICAL BRIEFS

Begins on page 152

the size and efficiency of the machine, are quite sizable and indicate the need for accurate, detailed maintenance planning. *APC Paper, no number.*

Inner-Cooled Turbine Generators. *By J W Batchelor, Westinghouse Electric Corp.*

One of the limits on the maximum capacity of turbine generators has been the ability to dissipate the losses in the rotor and stator windings. A major portion of the rotor winding is placed in slots machined on the rotor forging, with the winding insulated from the rotor body by mica formed to the same shape as the outline of the slot. Passages formed beneath the section of the slots containing the winding are connected to radial holes drilled in the rotor teeth at intervals throughout the length of the rotor body. The ventilating gas flows into the passages beneath the winding and through the radial holes to the surface of the rotor and to the gap. The loss generated in the rotor winding is absorbed by this gas and the gas flowing over the rotor surface, and is then carried to the cooler.

There are four components of the temperature rise of the rotor winding: (1) the thermal drop through the mica which forms the insulation in the slot, (2) the thermal drop through the rotor body, (3) the thermal drop at the surface of the ventilating passages and the surface of the rotor, and (4) the temperature rise of the gas itself. Increasing the gas pressure increases the mass of the gas and the ability of the gas to absorb heat. It also improves the heat transfer rate at the surfaces over which the gas passes. It has no effect, however, upon the thermal drop through the insulation or steel, so, no major change in the temperature rise of the winding can be effected by increasing the gas pressure.

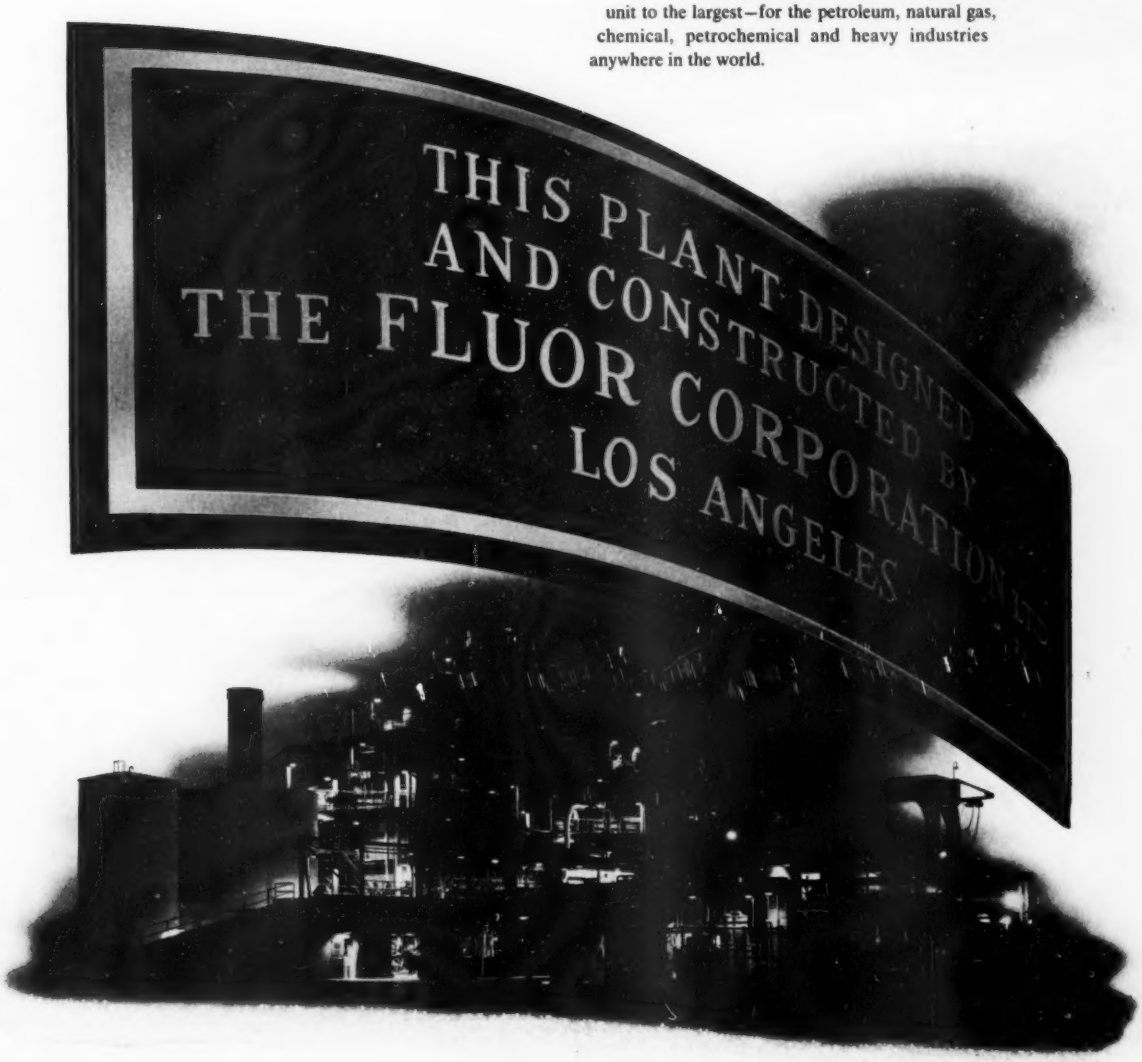
Although construction details of the stator are somewhat different than the rotor, the same general principles apply, and again, no major change in temperature rise is obtained by increasing the gas pressure.

These machines are essentially designed for 0.5 psig hydrogen pressure and have capabilities of 115% at 15 psig and 125% at 30 psig gas pressure. Under these overload conditions temperatures of winding are practically the same as under the 0.5 psig condition. But at gas pressures above 30 psig, the gains are so small that such operation is uneconomical.

Directions for ordering papers on p 154

HIGHGROVE, CALIFORNIA. California Electric Power Company's new, modern 60,000 KW steam-electric generating plant now in commercial operation here was designed, engineered and constructed by The Fluor Corporation, Ltd. Many design innovations make this plant one of the most unique in existence. Except for the control rooms and switch gear the plant is completely outdoors and was planned for operation with an absolute minimum of attending personnel. The entire job was completed in advance of the originally scheduled operating date notwithstanding the extreme difficulty of obtaining some items of material and equipment. Additional units are being added to bring the total output to 140,000 KW.

Fluor's ability to build efficient power plants has been ably demonstrated many times and is recorded in the illustrated brochure, "The Highgrove Story." Copies are available upon request. Fluor's broad experience also extends into the design and construction of all types of facilities—from the smallest unit to the largest—for the petroleum, natural gas, chemical, petrochemical and heavy industries anywhere in the world.



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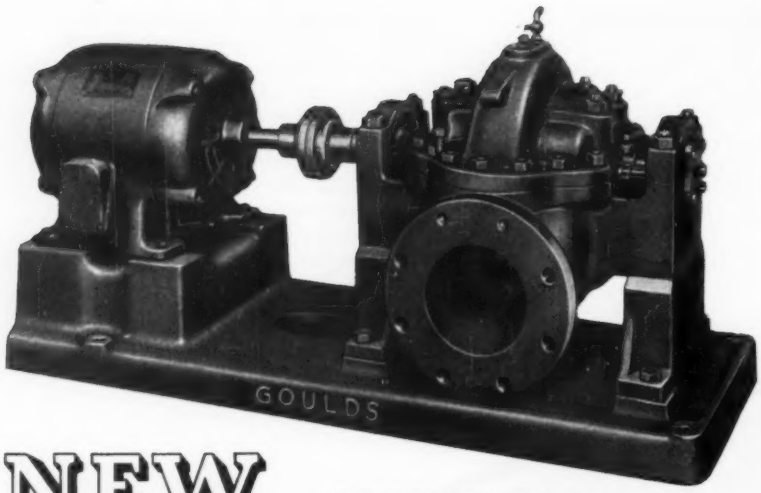

NEW GOULDS PUMP

GOULDS FIG. 3405 — Single stage, double suction centrifugal pump. Heads to 260 ft. Capacities to 6400 G.P.M. For general purpose pumping.

GIVES YOU 5 BIG COST ADVANTAGES

1 ***Combines seven design features that mean high operating efficiency and low maintenance.***

Every one of the following construction features is standard with this new design:

a. Renewable stuffing box bushings.
b. Bearing housings sealed against moisture and dirt.
c. Cowl-type glands suitable for use with quenching liquid.
d. Stainless-steel impeller keys.
e. Teflon water-seal rings.
f. Die-formed stuffing box packing.
g. Corrosion-resistant gland bolts.

2 ***Interchangeability of parts.***

Only three shafts and rotating parts assemblies provide for 19 pump sizes. This means you get:

a. Great flexibility in making field changes.
b. Low initial cost due to standardization of manufacture.
c. Reduced spare parts inventories.

3 ***Saves floor space.***

Short bearing spans cut over-all lengths as much as 50%.

4 ***Flexibility of stuffing box.***

You can use either conventional stuffing boxes or mechanical seals —and change from one to the other.

5 ***Easy rotation change.***

You can change from right- to left-hand rotation or vice versa in the field without construction change because of an unique device locking shaft sleeves.

GET FULL DETAILS from the 12-page illustrated bulletin, No. 721.6, covering the complete details of the new Goulds Fig. 3405, including specifications, interchangeability tables and performance curves. Be sure you have the whole cost-advantage story before you select another general purpose pump. Contact your nearest Goulds representative or write to Goulds Pumps, Inc., Seneca Falls, N. Y.

MEMBER HYDRAULIC INSTITUTE U.S.A.

Goulds PUMPS INC. Seneca Falls New York

More TECHNICAL BRIEFS

Begins on page 152

The inner-cooled design, as the name implies, provides a means for eliminating the temperature drops through the insulation and the steel by providing a path for the gas through the coils themselves. In the rotor winding, ducts are formed in the copper strips with radial holes for the gas to enter these ducts at the rotor ends and to be discharged at the center. Thus, with the gas in direct contact with the copper, the temperature rise of the winding is made up of only two of the four components present with the construction described previously—the thermal drop at the surface and the temperature rise of the gas.

The stator winding differs slightly, but the effect is essentially the same as on the rotor. In order to reduce the eddy losses, the conductors are divided into a number of small strands insulated from one another, the same as in stator coils of previous design. But in order to provide room for the gas to flow, the strands are separated widthwise in the slot by metal ducts which extend from each end of the coil. Because of eddy losses, these ducts also must be insulated the same as the strands in the winding. In addition, so there need be no break in the high-voltage insulation within the length of the core, the gas enters the tubes at one end of the stator winding and is discharged at the other end. There are then two major differences between the rotor and stator. On the rotor the gas comes into direct contact with the winding; on the stator a small amount of insulation protects the winding. On the rotor the gas flows from both ends to center; on the stator if flows from end to end.

By eliminating temperature drops through the insulation and steel, the effectiveness of increasing the gas pressure can be greatly improved. If such a generator were to be designed for operation at 0.5 psig to match a given turbine rating, its capability at 15 psig would greatly exceed that of the turbine. But if the design is based upon higher gas pressures, the capability may be made to match that of the turbine, thus taking advantage of the greater heat dissipating qualities to reduce the size and weight of the generator. *APC Paper, no number.*

Construction, Components and Control of Packaged Adjustable-Voltage Drives. *By Gerald Secor, Cutler Hammer, Inc, Milwaukee, Wis.*

Advantages of packaged adjustable-voltage drives and the components which make up the control that uses a dc generator for the adjustable-voltage

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is shop-fabricated piping that

saves manpower

The installation of Midwest Piping requires the minimum number of man hours because the difficult operations have been performed in the fabricating plants so that field erection time is reduced to a minimum. This makes possible earlier operation of the plant. Another reason for this time saving is that every subassembly is carefully checked before shipment to make sure it is dimensionally correct and accurate in alignment. The difficulty often encountered in securing skilled mechanics for field work makes this advantage of Midwest Shop-Fabricated Piping now more important than ever before.

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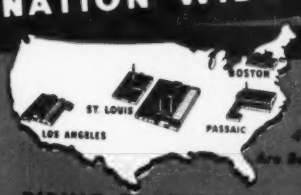

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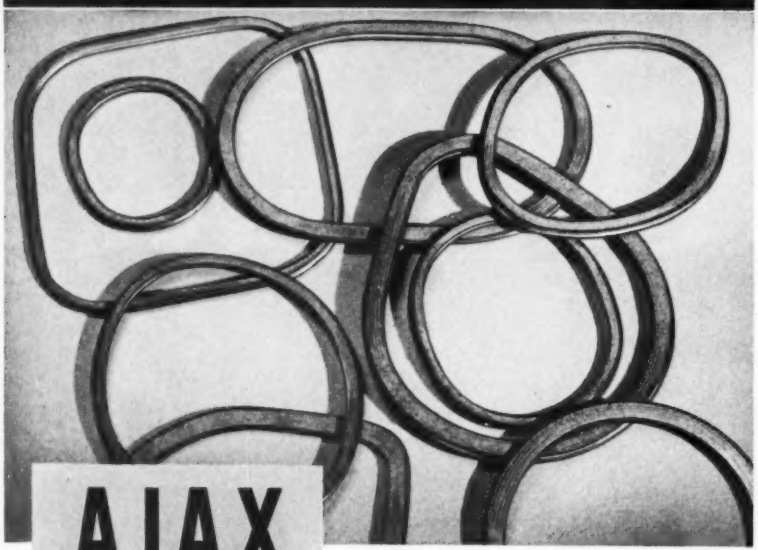

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More TECHNICAL BRIEFS

Begins on page 152

power supply are presented. Probably the greatest advantage of a packaged adjustable-voltage drive is that all the equipment required to supply the adjustable voltage is mounted in a single, ventilated enclosure. The ac drive motor, starter, start-stop pushbutton, dc generator and control panel are mounted in the enclosure complete with connections. Thus, the user need only wire the unit to the ac supply and make the connections to the dc motor and control station.

Simplicity of installation of the package unit makes it well suited for spot conversion. When laying out a new plant the ac wiring need be the only electrical consideration. If a machine is installed requiring a dc supply, a packaged adjustable-voltage drive may be specified and the dc supply along with the required control is obtained in a single unit. A packaged adjustable-voltage motor-generator set can also be used for constant-voltage supply to provide additional capacity for an existing dc system or to provide the only dc source in a small plant.

A packaged adjustable-voltage drive is well suited for applications requiring a wide range of operating-speeds controlled by the operator. It can provide close speed control, smooth acceleration and deceleration and rapid stops by dynamic or regenerative braking.

Package drives are not limited to obtaining adjustable speed. Many control functions may be built into them while proving all their other advantages. If auxiliary control is required it can be supplied on the panel with the rest of the control. This makes it possible to complete the connection for the entire unit and eliminates the need for extra control panels and enclosures. *AIEE conference paper. Can be obtained from the author.*

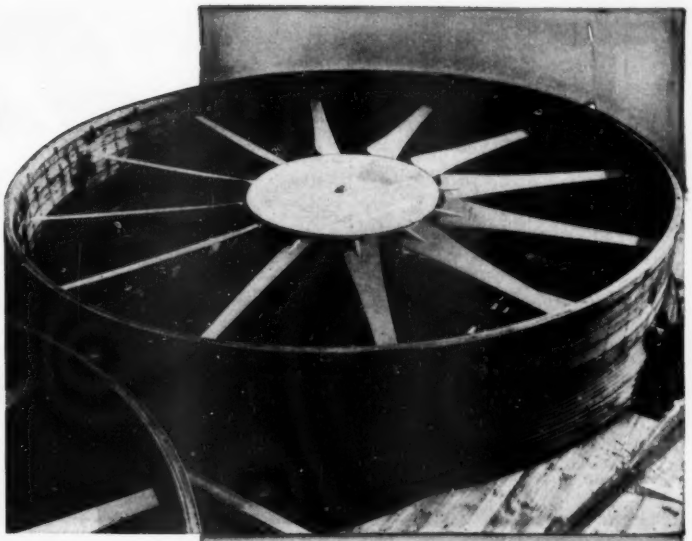
Directions for ordering papers on p 154

The Electronic Packaged Drive. *By E F Kubler, General Electric Co, Schenectady, N. Y.*

Electronic adjustable-speed motor controls have proved themselves in hundreds of industrial applications. Because of the ever widening demand for precise control of reasonable cost, standard electronic package drives are available in a range from fractional to over 30 hp. These small compact drives are used on office machinery, machine tools, automatic display stands and many other applications. Electronic drives have the following advantages.

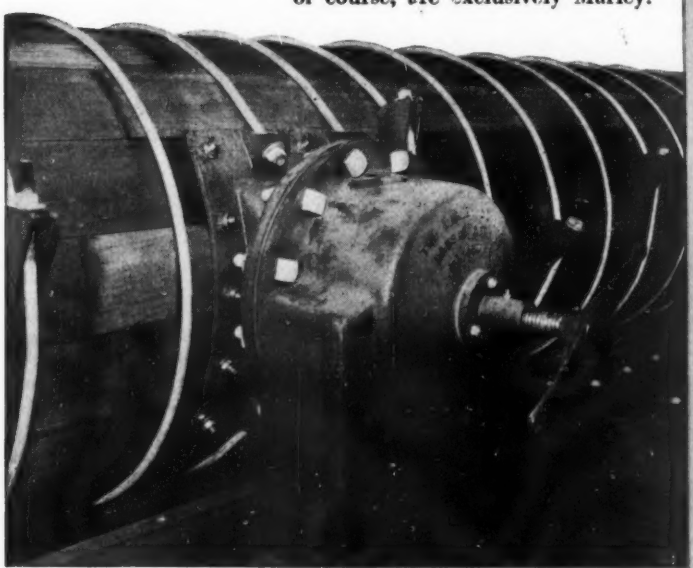
1. Compactness and light weight make them suitable for most applications.

exclusive Marley features that mean PERMANENT PERFORMANCE



Improvement of performance and service life of the vital elements of cooling towers is a continuing project of Marley research and engineering. The results of this effort set the pace for the entire industry.

Here are four advanced features that are incorporated into current Marley production.* They are distinct achievements in cooling tower design, and, of course, are exclusively Marley.



*Any cooling tower can be modernized with Marley design features.

Marley Multi-Blade Fans—

These fans are aerodynamically correct in design to move air in volume efficiently. Their further accomplishment is to remove pulsation with its damaging vibration.

Marley Patented Laminated Fan Cylinders—

Built of multiple plies of redwood, the Laminated Fan Cylinder is completely non-corrosive and vibration resistant. Field service proves its permanence.

Marley Redwood Pipe—

This header pipe is carefully prefabricated in Marley's wood fabrication plant for cooling towers (largest in the world). Its perfect fit and strong, adjustable steel bands on close centers assure its long life. On the job it is erected easily, quickly.

Marley Flow Control Valve—

Marley flow control valves insure equal distribution of water to each cell and effectively handle any quantity of water from full basin capacity to complete shut-down.

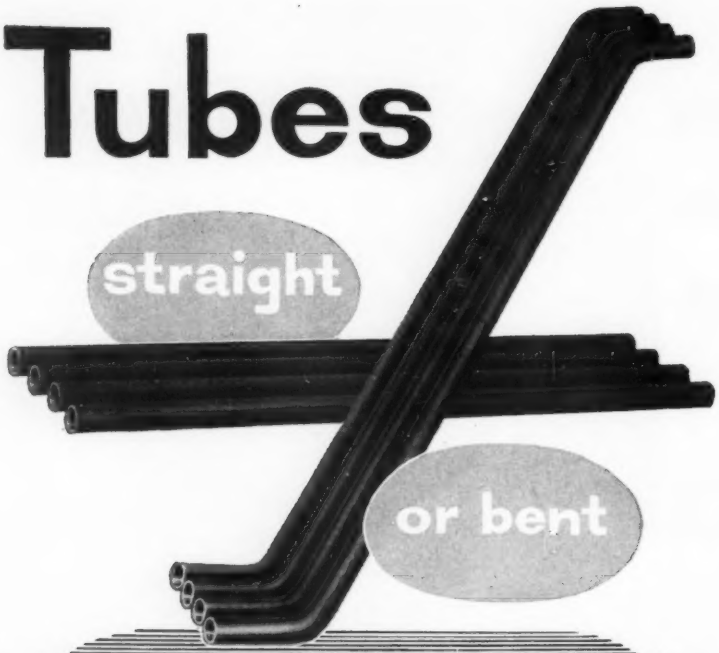
Ask your Marley Sales Engineer (in fifty cities) for detailed information about these achievements that have maintained Marley leadership.

MARLEY

The Marley Company

Kansas City, Missouri

Tubes



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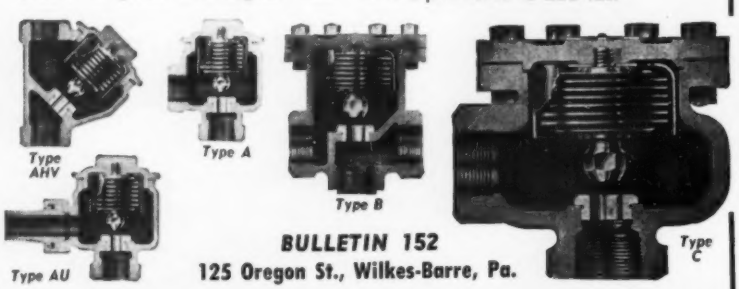
Following replacement of all steam traps of various makes, with Nicholson units, an Eastern college reports:—"An average coal saving of 1 carload per week besides much better heat distribution". Credit is given the higher and more even temperatures which Nicholson traps effect. See why large industrial and institutional steam users are increasingly standardizing on Nicholsons. 5 types; for heat, power, process; sizes ¼" to 2"; pressures to 250 lbs.



BULLETIN 152

125 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

More TECHNICAL BRIEFS

Begins on page 152

2. They are so flexible that there are few applications that cannot be handled by them.

3. Their high performance accuracy makes them an ideal drive for continuous industrial processes.

4. Their high speed of response makes them suitable for high-speed manufacturing methods.

5. Their wide range of speed and horsepower covers most industrial needs.

6. Their overall efficiency is as good or better than other drives.

7. Because of the absence of rotating machinery they require little maintenance.

8. Due to their flexibility and adaptability they can be used on most applications at moderate cost.

These features of the electronic packaged drives put them in good position when compared with others. In general it has been found that the use of an electronic drive increases the processing speed and improves the manufactured product. *AIEE conference paper. Can be obtained from the author.*

Directions for ordering papers on p 154

Packaged-Drive Design Problems. *By E H Vedder, Westinghouse Electric Corp, Buffalo, N. Y.*

The trend toward packaged adjustable-speed drives is increasing because of the many advantages they offer to machine builders and users. A packaged drive is easier to install because the many parts previously shipped separately are now factory assembled in a metal cabinet and tested. Drives that use motor-generator sets for power conversion in ratings up to 300 hp are considered in this paper. Ratings of these drives follow the same steps as dc motors. Only seven sizes of cabinets are required to package drives of 1 to 200 hp. However, the control functions which must be provided for are staggering. For example, about 1000 drive designs are needed to cover ratings from 1 to 30 hp, 230, 460 and 575 v, 60 cycles.

A few simple principles should be followed in applying and designing packaged drives. These are:

1. Packaging is not a necessity. Unless there is an overall advantage to the purchaser the drive should not be packaged.

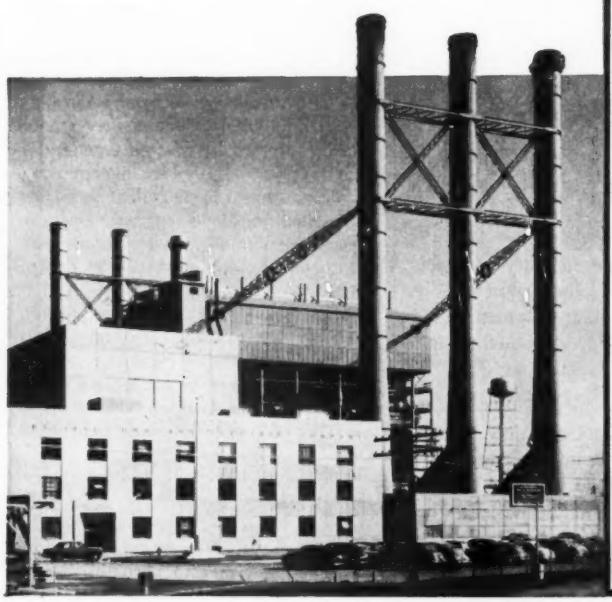
2. Engineering design cost tends to be higher on complex packaged drives than on non-packaged equipment.

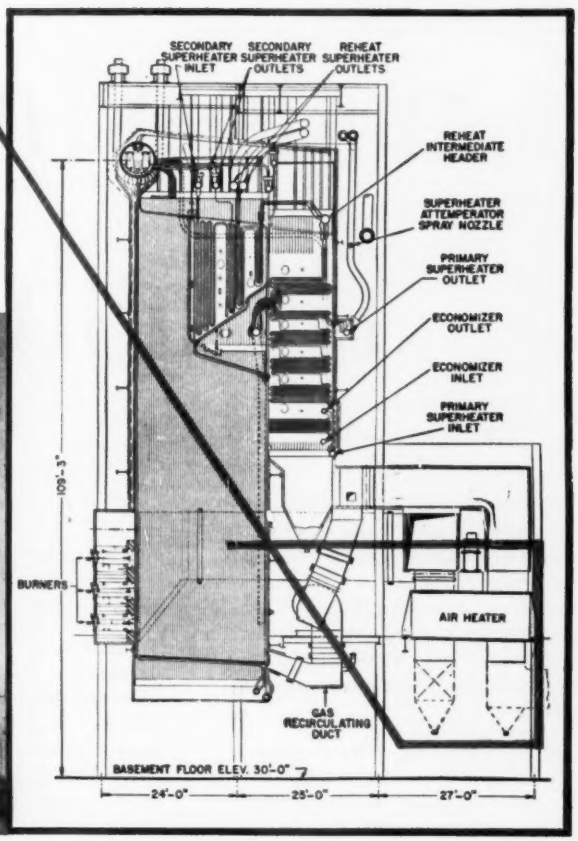
3. Drive designers must not be handicapped by the purchaser insisting on a specific solution to a problem merely

All Boilers at Moss Landing Steam Plant of the Pacific Gas and Electric Company

equipped with

LJUNGSTROM AIR PREHEATERS





In the country's largest single utility expansion program, costing more than one billion dollars, Pacific Gas and Electric Company is boosting its power capacity by more than 2,500,000 kilowatts. One of the five steam power plants in this program is P. G. and E.'s Moss Landing Steam Plant, designed and constructed by Stone & Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Department.

Three of a projected five 100,000-kw turbines are in operation now at Moss Landing. Steam for each of these three turbines is supplied by two 475,000 pounds of steam per hour Babcock & Wilcox Radiant Boilers with superheater outlet conditions of 1405 psi and 950 F. The two turbines yet to be installed will each be powered by one B&W reheat boiler (illustrated), designed to generate 850,000 lb of steam per hr at 1450 psi and 1000 F, reheated to 1000 F.

Each of the boilers at Moss Landing has been designed to incorporate a Ljungstrom Air Preheater. Those now in use preheat incoming air to 575 F, and cool exit gases to 350 F. Ljungstroms will be used also for the boilers being built.

Moss Landing is another in a long series of new stations and expansions to existing stations where Ljungstrom Air Preheaters have been specified for high-performance steam generating units. The unanimity with which the Ljungstrom has been accepted by boiler manufacturers, consulting engineers, and power companies is demonstrated by the fact that over 285,000,000 pounds per hour of steam capacity since 1945 has been served by Ljungstrom Air Preheaters.

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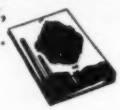
To learn more about Buell's **3 basic systems** of Dust Collection, Buell's Plant-Engineer-Team-Up, and how they can work for you—send for the new informative booklet entitled, "The Collection and Recovery of Industrial Dusts". Buell Engineering Company, Dept. 50-F, 70 Pine Street, New York 5, New York.



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ENGINEERED EFFICIENCY IN DUST COLLECTION

More TECHNICAL BRIEFS

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to follow tradition or a personal preference. *AIEE conference paper. Can be obtained from the author.*

Packaged Adjustable-Voltage Drives. *By S P Finnegan, W H Turner, Jr, General Electric Co, Schenectady, N. Y., and L Wolfson, General Electric Co, Lynn, Mass.*

Adjustable-voltage drives in which the adjustable-voltage source is a dc generator, the shunt field strength of which is varied, are covered. The principal advantage of these drives are:

1. Wide speed range below base by armature control at constant torque. This range can be extended above base speed by shunt-field control at constant horsepower.
2. Low threading or jogging speeds can be obtained easily.
3. Torque at starting, during acceleration, retardation and dynamic braking can be controlled easily and accurately.
4. Direction of machine-drive motor can be reversed by reversing generator-armature or shunt-field connections.
5. Since speed is controlled by adjusting generator field current, accurate speed, current and current-limit regulators can be included in the control circuit.
6. Several motors operating in tandem may be connected to one generator. Adjusting the generator voltage adjusts the speed of all motors simultaneously. Speed of each motor may also be adjusted by motor-field rheostat.

Preference for packaged equipment has increased because:

1. It is easy for the customer to order the equipment. He can think in terms of what he wishes to accomplish, and then gets a packaged unit to do this job.
2. Factory assembled equipment greatly reduces installation costs.
3. Packaged units are more compact and require less space than non-packaged equipment to do the same job.
4. The package manufacturer takes complete responsibility for the equipment's operation. *AIEE conference paper. Available from the authors.*

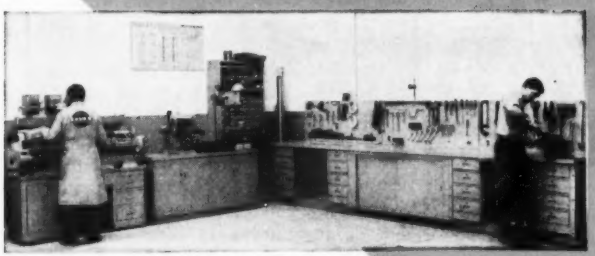
Overload Protection of Adjustable-Voltage Drives. *By W Schaelchlin, Westinghouse Electric Corp, Buffalo, N. Y.*

We used to think automatically of contractors on circuit breakers to protect motors against overloads. Adjustable-voltage drives with their own power supply changes this concept. Because the generator field can be used to control the power to the motor, it is not

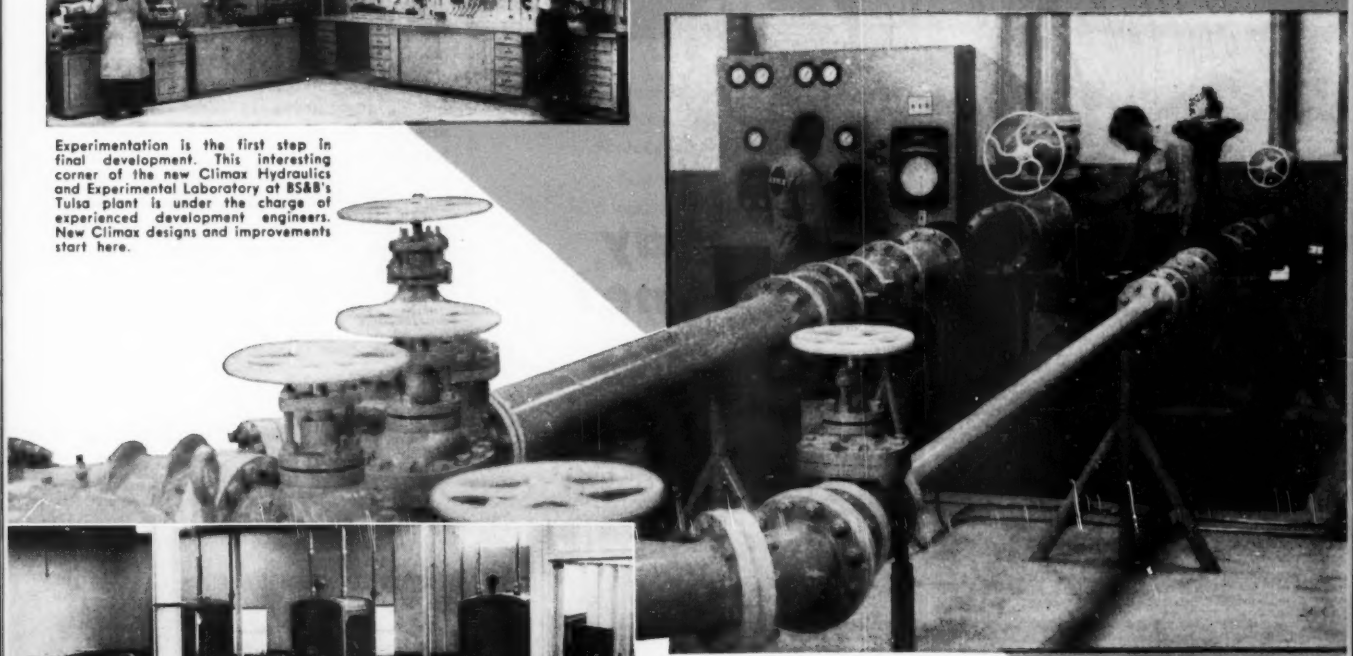
Directions for ordering papers on p 154

Testing the performance on which BS&B reputation has been built;

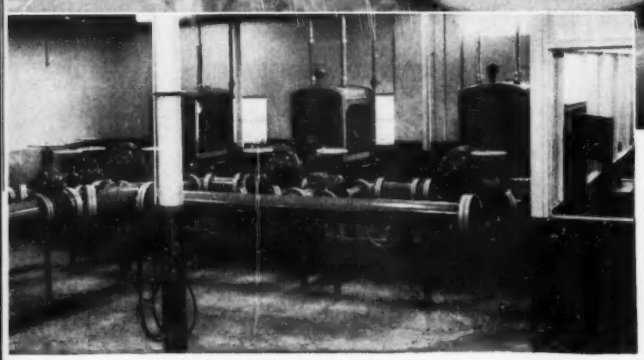
Pre-Proving CLIMAX CONTROLS to Insure On-The-Job Efficiency



Experimentation is the first step in final development. This interesting corner of the new Climax Hydraulics and Experimental Laboratory at BS&B's Tulsa plant is under the charge of experienced development engineers. New Climax designs and improvements start here.



The finished control on the "torture rack." Meter runs flow test the valves up through 10". Strain gauge equipment analyzes forces and stress under performance. Control panel in background regulates engines driving the pumps and registers flow data for calculation.



Pump manifolding for the 3 engine-driven pumps which will deliver up to 4500 gallons per minute at a 100 lb. discharge for high volume tests. Pumps can also be manifolded for series operation, in which case 300 lbs. of water at 1500 gallons per minute can be delivered.

There's no question about a Climax Control giving the satisfactory service for which it is designed. That performance is tested and proven before the control goes into the field . . . checked for minimum and maximum capacity. Flow, flow effects, valve characteristics and strain results are all evaluated by experienced engineers. Through the new BS&B Climax Control Hydraulics laboratory come a continuing series of answers to the more efficient, safe and profitable application of automatic controls. One test suggests another, one application is adapted to a similar problem. The net result: Through research, better engineering, and accurate pre-testing, comes a more efficient Climax Control.

New Climax Controls Hydraulic and Experimental Laboratory

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Clark makes the famous patented Duo-Step inverted bucket traps that handle *double* the usual amount of condensate. In addition, Clark manufactures open bucket and float type traps as well as pressure regulators and strainers.

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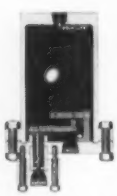
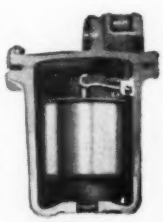
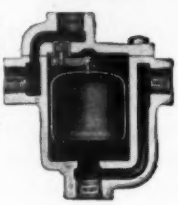


SERIES "450" FLOAT TRAP. For drainage where continuous flow is desired, or for maintaining liquid levels. Steel construction for pressures to 600 P.S.I. Compound linkage gives larger capacity. Size ½" to 2".



SERIES "80"-D (DUO-STEP) TRAPS. Cast semi-steel construction for pressures up to 250 P.S.I. and temperatures to 450°F. Equipped with Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes from ½" to 2".

"Y" SELF-CLEANING STRAINERS. Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S.



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More TECHNICAL BRIEFS

Begins on page 152

necessary to open the armature circuit to stop the motor. It is possible to operate with a closed loop system without circuit breakers which, because of the control, has many advantages.

Overload current-limit protection can be provided with field control by inherent time delay, external time delay, differential field feed-back, field fluttering relay and by means of the regulating system. Operation of the field circuit under fault conditions includes switching of generator field with generator armature circuit open and switching of field under overload. On some large machines high-rupturing-capacity circuit breakers are installed between the generators and motors, and on heavy overloads a high-speed overload relay trips a fast-operating field switch in the motor and generator field circuits. *AIEE conference. Paper can be obtained from the author.*

Bids for six 100,000-hp hydraulic turbines for Chief Joseph Dam on the Columbia River near Bridgeport, Wash, have been called by the Corps of Engineers for opening May 6 at Seattle. Each turbine must have a rated capacity of 100,000 hp at 100 rpm at 165 ft head and 82,000 hp at 148 ft head. Specifications call for vertical shaft, single-runner, Francis-type turbines with plate-steel spiral cases embedded in the concrete substructure of the powerhouse. The first unit is scheduled to go on the line Sept 1, 1955.

Unless new hydroelectric projects are started on the Columbia River and its tributaries in 1953 and succeeding years, the Pacific Northwest faces the prospect of another power drought, as well as retarded growth of industry by 1960-61. That is the prediction of Bonneville Power Administration in its 1953 Advance Program report.

Present Columbia River projects now under construction will handle power needs for 1957-58, but new power sources equal to one and a half Bonneville Dams and a federal investment of $300 million will be needed every year for the next decade to satisfy future energy requirements, expected to double by 1960.

The Ampere Medal, one of the highest French scientific honors, has been bestowed upon Professor Henri G Andre, eminent French scientist and inventor, by the Societe Francaise de Electriciens. Professor Andre received the award in recognition of his outstanding contributions to electrical science, and, in particular, for his work in the field of electrical energy storage. Professor Andre has devoted many years to the development of the first practical rechargeable silver-zinc battery, the smallest and lightest rechargeable battery to be found in the world today.

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Here's power plant performance in a compact package . . . backed by long experience in the design and manufacture of completely factory-assembled steam generators.

Superior Water-Tube Steam Generators provide efficient, economical steam for power, heat or process in industrial plants, commercial buildings, institutions and public utilities. Their rugged, heavy-duty construction assures long-lived dependability and minimum maintenance throughout years of hard usage. Each unit is ***performance rated*** and thoroughly tested at the factory to insure high efficiency operation at maximum capacity.

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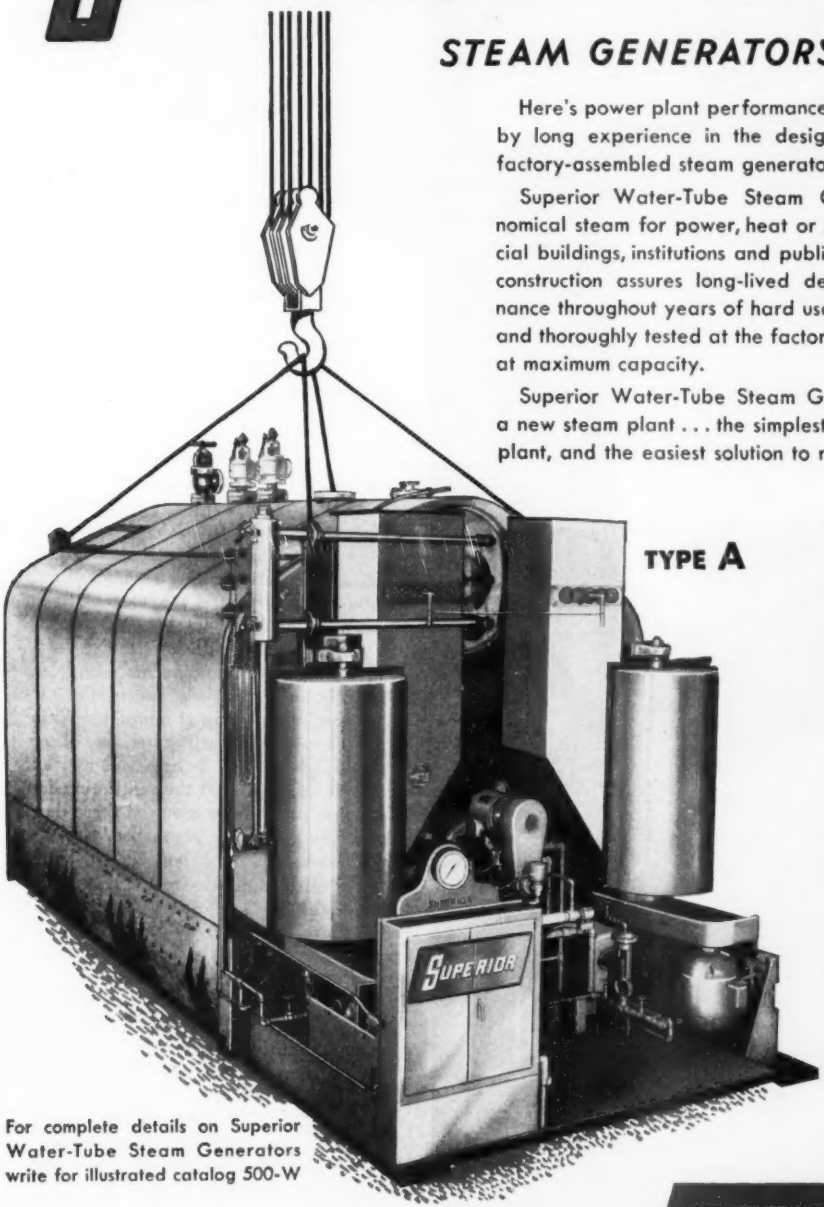

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Steam Production News

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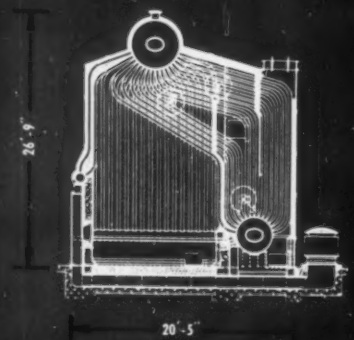
Two Type K Boilers By Bigelow provide up-to-date steam production in the recently modernized heating plant of the Army Medical Center, Walter Reed General Hospital, Washington, D. C.

Each boiler has a capacity of 75,000 lbs. of steam per hour — continuous and 82,500 lbs. of steam per hour for 4 hour peaks. Both boilers are oil-fired with four burners per boiler. Combustion control equipment is mounted on a central panel serving both boilers.

The boilers are built and installed in accordance with specifications of The Corps of Engineers U. S. Army. The mechanical contractor was Harry E. Nau & Co., Inc., Washington, D. C.



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MARMADUKE

Continued from page 144

practically raining in the engine room, that's why.'

"'RAINING!' I barked, ready to pop my safeties. 'How could it be raining inside if it happened before you had that roof fire—or did you leave me ashore in that last port?'

"'You got it right, but you still don't understand,' he explained. 'Steam filled the engine room, and when it came in contact with the cold inside air, why, it just naturally condensed and practically rained inside, that's how.'

"'Look, Chief,' I pleaded, 'I'm not good at riddles, and right now I feel a little waterlogged. How could there be cold air in your hot engine room in the first place?'

"'How?' he asked, as if he were talking in his sleep. 'Because it was down to zero outside last night, and we had removed the little fan room above the switchboard the day before. We had to remove the asbestos shielding above the switchboard panels, also. That's why we put temporary plywood panels above them so it wouldn't rain in on the panels while the roof was open.'

"'OK', I answered, 'but where did the steam come from that condensed? And why didn't the ventilating fans in the penthouse over the switchboard pull it out before it could condense and rain all over the bus bars?'

"'I guess you still don't understand,' he commented, sounding more hopeless than before. 'You see one of the turbines was started up at midnight. While Joe Shotton was starting her, one of her glands developed a bad steam leak. But he couldn't start the ventilating fan because it had been removed three days ago, along with the penthouse.'

"'Look, Chief,' I begged, 'just tell me why the fan was removed and I'll keep still.'

"'Sure,' he answered quietly. 'I'll tell you why. You see the boss had the old roof torn out and the contractor was putting in a new roof. So they had to remove the penthouse and the fans above the turbine room until they could get the new roof down.'

"'I think I've got it straight,' I said. 'Wow! I'll drive right out to the mill and see about getting repairs started.'

"Fifteen minutes later I was standing in the engine room, looking at one awful mess. And I saw what the Chief meant about that electrical equipment needing 'dehydrating.'

"I got busy and called in outside electricians, got them at their homes. They showed up shortly and started dismantling the equipment to dry it out. We removed the generator field and exciter of one turbine unit. Also two

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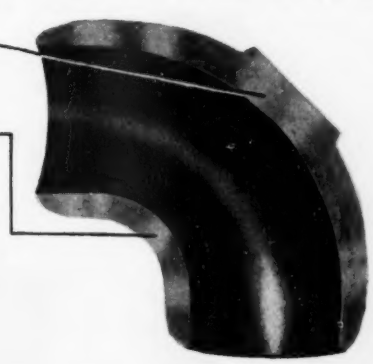

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"T" Type Strainer

STRONG

MARMADUKE

Continued from page 220

motor-generator sets, including several smaller motors.

"Moisture had to be taken out of spacer blocks on the bus bars. Altogether, we removed over 150 spacer blocks. We cleaned, baked and reassembled them, working around the clock.

"We also had to remove rheostats, voltage regulations, resistors and equipment from the switchboard. Cables were pulled from conduits, treated, and some of them renewed. Then we installed jumpers on the bus bars to make up for the 2-foot sections burned. As the Chief put it, we had the plant 'dehydrated' and back in shape in 36 hours.

"'Why did all that happen?' roared Marmaduke, glaring at me, as if I was to blame. 'Because a turbine gland leaked on a clear, cold night, while a new roof was in the process of construction. That open roof let in cold air to condense the escaping steam from a turbine gland that had to go haywire just at that time. And, as luck would have it, the exhaust fans happened to be removed at the same time, so they couldn't remove the steam.'"

With that, Marmaduke got up from his swivel chair and grabbed the 2½-gallon foam-type fire extinguisher from his office wall.

"Where's the fire?" I asked, surprised at this unexpected maneuver.

"Right here, in my ballast tank," he answered, pointing to his midship section, "I burn up every time I think of that paper mill."

Then he stuck the hose in his mouth and turned the extinguisher upside down. But just as my eyes started popping from their sockets, I detected the unmistakable fumes of Sandpaper Gin permeating the room.

I turned and headed for the creaky stairs. "WOW," I said to myself, what a story and what a guy. But Marmy must have really been burning because I heard the loud gurgle-gurgle all the way down the steps as he kept dousing that fire.

WATER TREATMENT

Continued from page 77

temperature does not get high enough, by all means convert it into a crude open heater. This is easily done by inserting a live-steam coil or, better yet, by injecting the steam directly through a perforated line extending across the bottom of this tank. Either method can be thermally or manually controlled.

Even with efficient deaeration you need a chemical corrective like sodium

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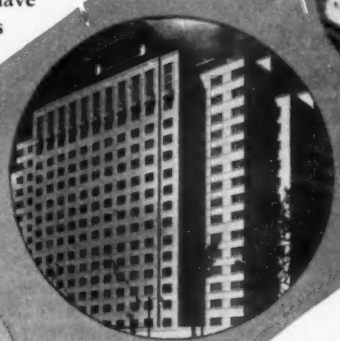

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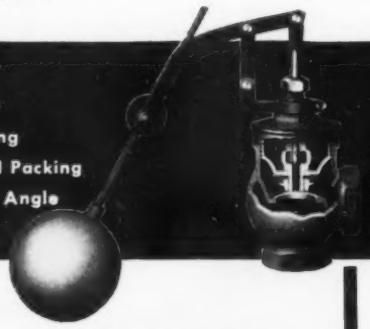

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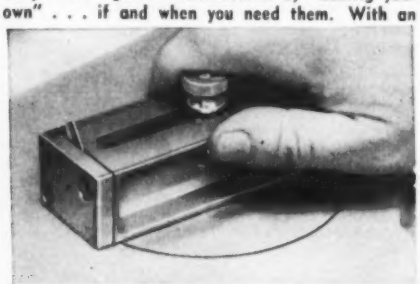

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WATER TREATMENT

Continued from page 222

sulfite to eliminate the last traces of oxygen from the feedwater. This chemical renders the residual oxygen inactive by converting it into its sulfate form, which is highly soluble and non-scale-producing. Sodium sulfite can become objectionable only when it takes a considerable amount to clean up after inadequate deaeration. The main objections are that it (1) is slow in its reaction (2) increases the sodium sulfate content of the boiler water, which results in additions to the sodium alkalinity and total dissolved concentrations of the water.

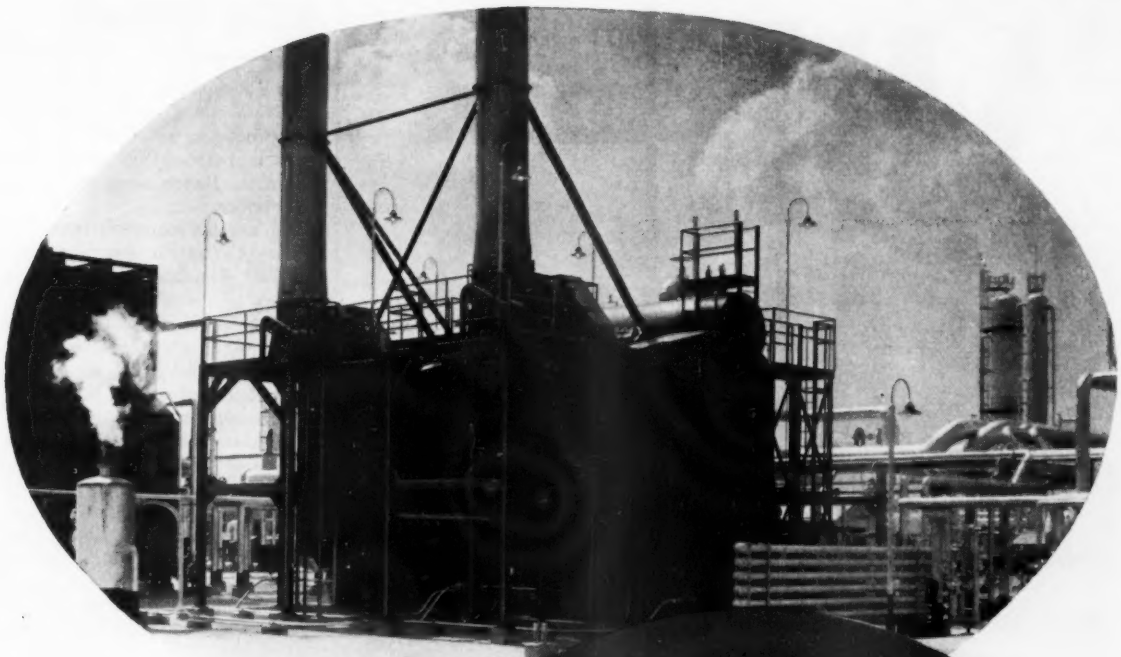
For proper control of oxygen correction, test boiler water periodically as warranted by operating conditions. Always carry a slight excess of sulfite as a precautionary measure.

Internal Treatment. The combined calcium and magnesium dissolved ingredients of a water constitute its total hardness. As previously discussed, (in January and April scale-formation articles) we certainly want to avoid having (1) magnesium precipitate out in the boiler as silicate or sulfate, or (2) calcium appear in the form of either carbonate, sulfate or silicate, because all are scale producers.

Various mechanical devices have been offered for averting scale formation, but they prove limited in scope. So far, chemical means give best results and a vast variety of boiler compounds are available. To date, however, the phosphate-organic type of treatment correctly applied ranks as the most effective. But, like any other, it needs help in the way of proper supervision and competent advice in difficulty.

Any of a score of sodium-phosphate compounds, from the simple meta form to the complex poly-phosphates, work well, either alone or in combination. Their particular selection depends on the nature of your conditioning problem, particularly whether a reduction or increase in alkalinity is sought for the boiler water. The monosodium and meta-phosphates are acidic, disodium is fairly alkaline, the complex phosphates for the most part are more so, while trisodium is strongly basic.

We suggest you avoid the use of an alkali entirely, or hold it to a bare minimum. Desired alkalinity range should be reached by precalculated proportioning of the various phosphates. When needed, you can use soda ash. But, while this chemical is a mild alkali and lends itself to easy control, it furnishes additional carbon dioxide to the steam upon undergoing breakdown in the boiler water. This gas, we know, can be quite corrosive in the return system,



Wickes steam generators help refineries operate efficiently year after year

147

Year after year, Wickes Steam Generators have been helping the oil processing industry keep their operations efficient and their maintenance and operating costs low. In many of America's largest refineries and natural gasoline plants, Wickes boilers have been on the job almost constantly for ten, twenty or even thirty years and are still operating at a high degree of efficiency. They can do the same in your plant. Wickes can fill your requirements for any type of multiple drum boiler up to 250,000 lbs. steam per hour at 1000 psi., adaptable to any standard method of firing. Units capable of steam production up to 35,000 lbs. per hour at 1000 psi. can be shop-assembled for immediate installation. Consult your nearest Wickes representative or write us today for descriptive literature and complete information.

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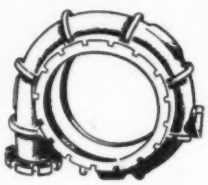

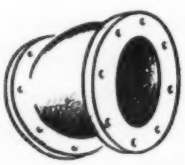

In coal-fired stations where proper handling of abrasive ash can save dollars, no better material can be used than ABK Metal.

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1488

WATER TREATMENT

Continued from page 224

and it's smart to prevent its formation where possible. Caustic soda is a non-gas-producing alkali, but it proves violent in reaction and most difficult to regulate. Hence, never use it in a package boiler.

An organic coagulant (tannin extract, seaweed extract or a corn-starch derivative, or even a combination of two of these) is a vital adjunct to the phosphates. The organic comes either dry or in liquid state, and you feed it in conjunction with or incorporate it in a formulated mixture of the other chemical correctives.

Calcium Correction. The phosphate treatment converts the boiler water's concentrating calcium hardness into tricalcium phosphate, Fig. 3, a quite insoluble compound that readily falls out as a fine powder. But, merely adding adequate phosphate does not insure complete precipitation of calcium. You need a definite minimum degree of alkalinity to drive this reaction to completion, otherwise both calcium and phosphate remain unreactive with each other.

Since calcium is most always the principal component of hardness, you want to eliminate it completely from the boiler water in the form of a non-scale-producing phosphate. Consistently carrying a slight excess of phosphate and a pH value of the boiler water above 10 does the trick.

Tricalcium phosphate, though, is not without a drawback. Being somewhat heavy and a fine deposit, it readily clings to metal surfaces and becomes well packed. An organic coagulant serves to prevent this. It gives the calcium phosphate particles a slimy coating, thereby keeping them apart and mobile. The entire sludge, thus rendered fluid, is easily removed by blowdown. The effective, minimum quantity of organic to use varies with its type. But it should be in direct proportion to the amount of calcium precipitated, hence, also to the phosphate added. So for this reason, add the organic with the phosphate corrective.

Magnesium Correction. Unlike calcium, we do not precipitate the boiler water's concentrating magnesium hardness as phosphate, because magnesium phosphate is sticky and difficult to remove. An organic coagulant has little effect on it. Only treatment is to maintain sufficient alkalinity to precipitate magnesium as hydroxide, Fig. 4, which comes down as a gelatinous floc.

Silica Retention. Through the maintenance of favorable boiler-water alkalinities we can also retain silica in solution by keeping it constantly soluble

"No More Sticking Rings..."

... says L. W. Marple
Supt. Municipal Light Plant
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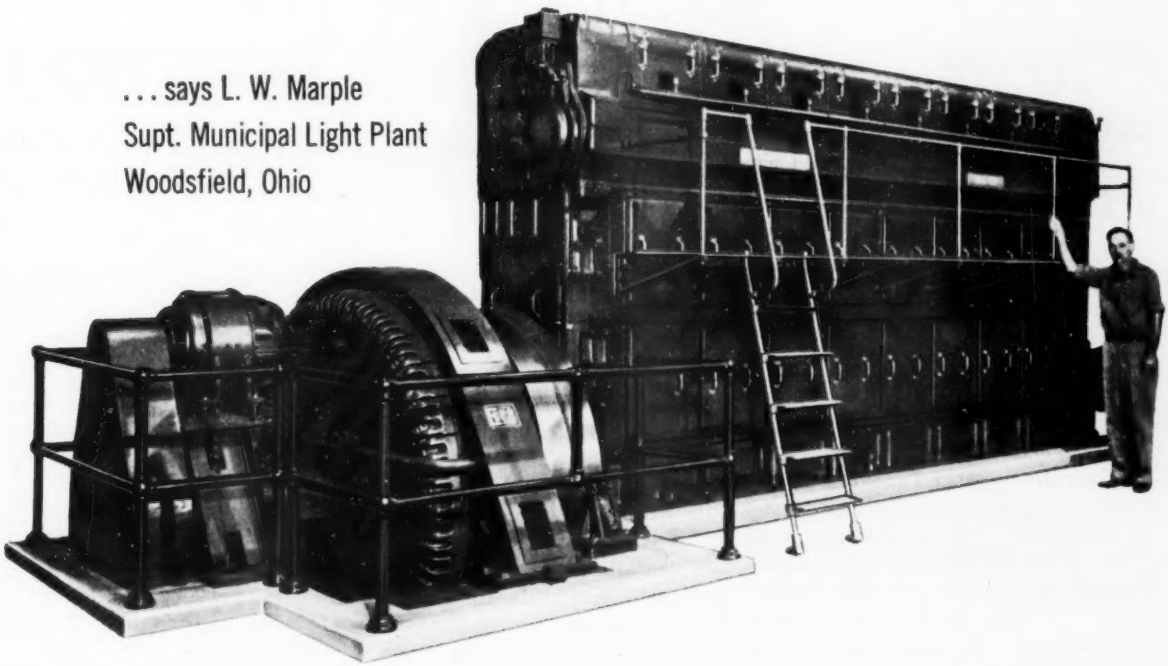

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Perhaps a Sinclair Lubrication Engineer can solve *your* lubrication problems. Call your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

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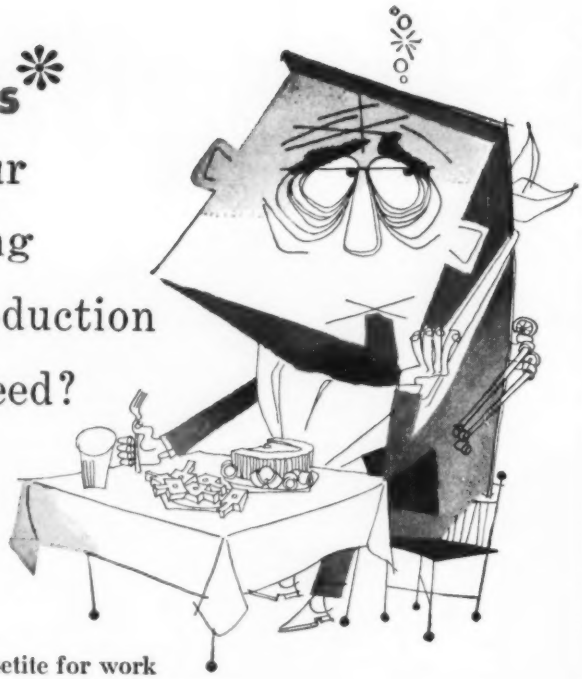
save wear and replacements

does

coil-itis*

have your processing tank production off its feed?



When the appetite for work of your heating and cooling processes diminishes, the trouble may well be coil-itis. For, downtime due to pipe failures and limitations can seriously delay your production flow. Switch to Platecoils, the new tonic for production, as revolutionary as the new wonder drugs. Platecoils take 50% less tank space leaving more room for greater payload. They heat or cool 50% faster. They simplify maintenance and save hours of downtime. Equally important, Platecoils cost as much as 50% less in the first place. Platecoils cure production troubles involving heat transfer and give production a shot in the arm.

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PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

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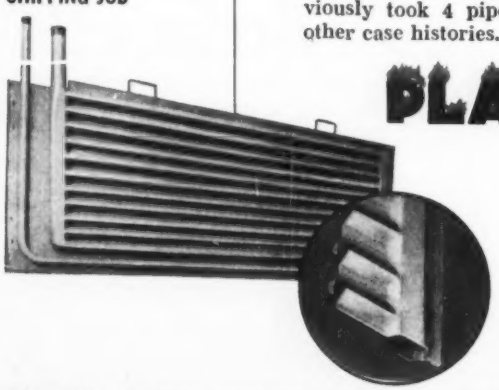
At Sealed Power Corp., installation of Platecoils has completely eliminated a 6-to-8 hour-a-day chipping job. Three Platecoils now heat a tank that previously took 4 pipe coils. Ask about other case histories.



PLATECOIL

REPLACES PIPE COILS

*

Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

PLATECOIL DIVISION, KOLD-HOLD MANUFACTURING CO., LANSING 4, MICHIGAN

WATER TREATMENT

Continued from page 226

as sodium silicate, Fig. 5. The higher the feedwater's silica content, however, the stronger the boiler water's alkalinity has to be to restrain the silica from reacting with the hardness to produce scale.

Alkalinity Restraint. The stronger the boiler water alkalinity, the greater the driving force exerted behind the above desired reactions and, therefore, the better the results. But we also have to prevent alkalinity concentrations from developing too high. Otherwise, foaming starts and a severe carryover of solids with the steam follows. With a package boiler, alkalinities yielding a pH value of 11.3 are generally a safe maximum. By carrying boiler-water alkalinities within the pH range of 10-11.3 the calcium hardness precipitates out completely as phosphate; the magnesium hardness comes down entirely as hydroxide; silica stays safely in solution.

Blowdown. Blowdown rate depends on the boiler water's alkalinity, silica and total solids concentrations. Give a package boiler a minimum of two sludge blows daily as standard practice, one in early morning, the other in late afternoon during relatively light loads to take advantage of any settling out of boiler-water precipitates. When you have to increase blowdown, space the blows equally between these primary two. For a packaged-type unit in particular, frequent short blows prove more effective than several long ones.

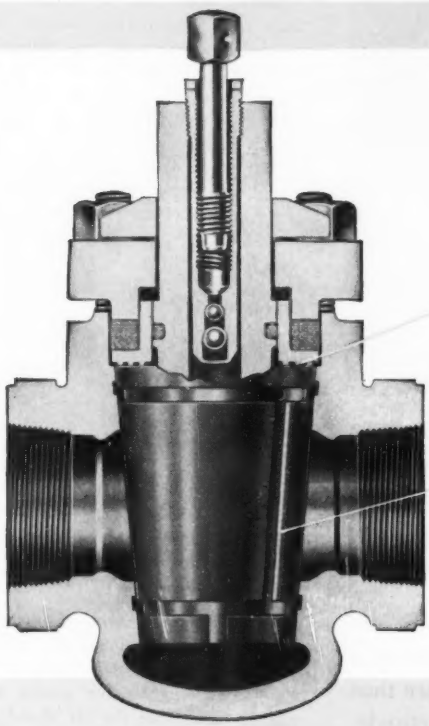
Where a high blowdown rate seems in order, put in a continuous blowdown system. Such a boiler-water bleed can connect through the surface blowoff tapping in upper side of shell. But even with a continuous blowdown in operation, keep up the minimum two bottom blows daily.

Chemical Feed. Also feed internal treatment chemicals as a daily routine, too, but not by shot-feeding methods because package units are too sensitive. Rather the correctives can be drip-fed into the receiving tank to maintain uniform chemical balances. But, better still, pump the treatment separately and continuously into the boiler through a continuous feed connection made at the cross fitting of the return line just outside the boiler shell.

Control Tests. Day-by-day control is a must for satisfactory internal conditions. Where the operating pressure is below 100 psi and conditions are fairly stable, you can establish a definite blowdown practice and regulate chemical-treatment feed daily by a simple phosphate colorimetric test of boiler water. But for pressures from 100 to 250 psi,

Oh, I see

OIC now offers a complete line of Lubricated Plug Valves . . .



with two added features

1 Triple seal gives more effective sealing at shank with ease of turning.

2 Lubricant grooves that are never exposed to the flowing liquid.

OIC Tapered Lubricated Plug Valves assure positive, leakproof control of flow . . .

O-Ring . . . under initial compression, gives extra protection against leakage past shank.

Resilient Packing . . . completely enclosed in nonrotating metal parts, tends to seat the plug tightly in body without excessive cover tightness.

Labyrinth Seal . . . series of concentric rings on gland collar make firm contact between collar and top of plug face, providing additional seal.

2 Vertical Lube Grooves . . . 180° apart. When plug is given quarter turn, neither of these grooves is exposed to liquid flow.

Lubricant Chamber . . . under pressure from screw piston, lubricant creates upward force during lubrication, tending to free plug for easy turning.

Plug Lapped to Body . . . to assure perfect, leakproof fit.

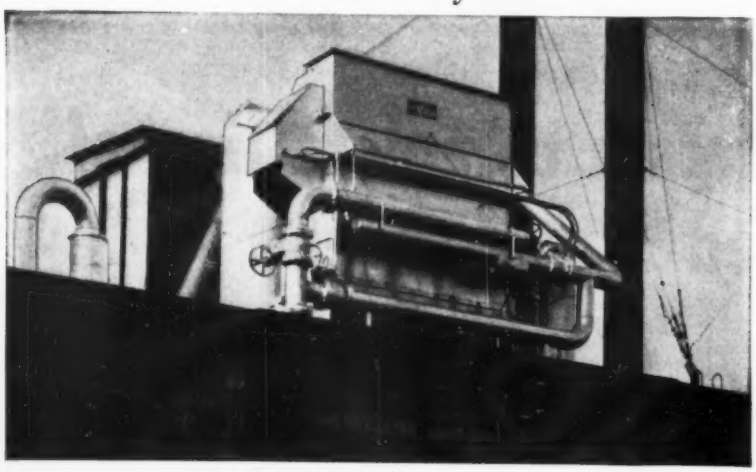
Order in semisteel or steel . . . from your local OIC Distributor. Write for literature describing the advantages of OIC Lubricated Plug Valves.

OIC FOUNDED 1903

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, IRON & BRONZE, LUBRICATED PLUG VALVES**

Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.



How to Get Drier Compressed Air:

It prevents many troubles and saves much expense

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave. New York 17, N. Y.

Experienced District Engineers in All Principal Cities of U. S. and Canada

WATER TREATMENT

Continued from page 228

daily testing for alkalinity and chloride concentrations can best govern amount of blowdown.

In any case, carry out the control of your boiler-water conditioning under the constant surveillance of a competent chemical engineer in this field. At regular intervals, samples of the raw water, feedwater, boiler water, condensed steam and returns need complete analysis. A study of these analyses along with current plant operational data should then be the basis for supervisory recommendations.

Boiler Openings. No treatment, however tried and proved, should be employed any length of time following its adoption without periodic checkups. Take down the boiler for at least two inspections during first six months of trial. Then, with satisfactory internal conditions established, the openings can possibly be extended to a mid-year washing out and an annual thorough cleaning. If the unit is undergoing descaling, it has to be cleaned at short intervals. The frequency depends on the initial state of scale and the progressive improved stages observed thereafter.

EDITOR'S NOTE: *In another article to follow, the subject of water treatment for packaged watertube boilers will be discussed.*

GAS TURBINE

Continued from page 84

the generator. Air compresses to a 5.5 pressure ratio, and turbine-inlet temperature is designed for 1450 F maximum. An evaporative cooler or air washer humidifies the air ahead of the compressor inlet. At air conditions of 100-F dry bulb and 78-F wet bulb the inlet air cools 20 F, and raises unit capacity by 450 kw. This incremental capacity is obtained at a cost of about $20 per kw.

The shell-and-tube type regenerator has a design effectiveness of 80%. Total pressure drop of both air and gas sides equals 5% of the absolute pressure. Set in a vertical position, the regenerator supports the exhaust stack on its upper end.

A cooling tower dissipates the heat rejected by the lube-oil system and the turbine cooling-water system. It has a cooling range of 105 to 95 F at 78-F wet bulb for 500-gpm capacity. A 5-hp motor drives the cooling-tower fan through a V-belt.

Some difficulties have been experienced since the gas turbine was in-

THEY'RE LOOKING DOWN YOUR PIPELINE...

Those twin scourges of industry—Lost Production and High Maintenance—are constantly drawing a bead on economical operation . . . looking down this nation's arteries for the lines of least resistance to heat, pressure and corrosion.

There *is* one way to spoil their aim: make sure that *your* pipe and tubing sections are joined with fittings of a kind that match them in chemical and physical properties, in strength and weight.

W-S Double-Diamond FORGED STEEL Fittings in both screw-end and socket-weld types give you all these qualities . . . provide life-of-the-line joints for any kind of make-up.

Literature is available . . . write for it.

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WATSON-STILLMAN FITTINGS DIVISION

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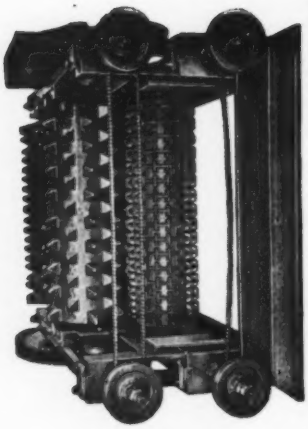


Crusher is pictured without hopper and sprocket guards, but is delivered complete.

TWO STAGE — DOUBLE ADJUSTMENT

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE COAL in ONE operation. Compact design simplifies structural supports, and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

T. J. GUNDLACH Machine Co., Belleville, Ill.

GAS TURBINE

Continued from page 230

stalled. The variable-angle turbine nozzles showed some tendency to stick, although they did not actually stick in service. Reworking the parts eliminated the binding tendency. A blowoff valve, added to the high-pressure side of the regenerator, limits the load-turbine overspeed to safe levels if high load is dropped and the second-stage nozzles do not open fully.

There have been several points of oil leakage that will be fixed by replacing some bearing seals during the next overhaul. An expansion joint will be installed in the regenerator shell at that time to reduce stresses from severe differential expansion between tubes and shell during operation.

The Dixon Street Plant runs on a standby basis, needing only a minimum operating force. Someone must be on duty 24 hours a day to handle radio dispatching of the distribution, maintenance and service personnel in a 30-mile radius from the plant, and to act as an emergency relay station for the main northern dispatching point at Sherman.

To do this, a 5-man crew was established including a chief engineer to act as general supervisor of the plant crew and to handle the necessary records and correspondence, as well as the plant. Three regular-shift operators and a relief operator maintain the 24-hr requirements for seven days a week. Each operator puts in one extra 8-hour day per month to complete the schedule.

HYDRAULIC GOVERNORS

Continued from page 83

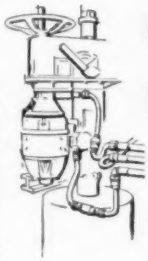
ceiving piston exactly matches rate of return of ballarms to vertical.

At the cycle's completion, engine will be running at its *original speed*, ballarms will be vertical, floating lever is horizontal, control ports are closed, receiving piston is back to its original position, and power piston is up at a new position supplying increased fuel for the increased load, Fig. 4.

Load Decrease. When load drops off, the governor goes through exactly the same steps as for load increase, but all movements are in the opposite direction. Sequence can be followed in Fig. 5, 6 and 7. In Fig. 5 the ballarms have moved out and lifted the pilot-valve plunger. The power piston moves down, Fig. 6, reducing the fuel supply and lifting the actuating piston. This causes the receiving piston to move down, to lower the pilot-valve plunger and close the control ports.

In Fig. 7, oil leakage through needle

PYLE-NATIONAL



PLUGS and RECEPTACLES for Motorized Valves

- *Shorten out-of-service time*
- *Assure proper reconnection*
- *Save time and labor*

Pyle-National's safe, easy to handle heavy duty plugs and receptacles quickly pay for themselves when used for connecting electrical equipment that must ever be relocated or disconnected for inspection or repair.

Labor expense involved in disconnecting individual wires, (or breaking soldered connections), and marking wires and terminals is eliminated. The length of time valuable equipment is kept out of service is cut to a minimum.

There is a Pyle-National connector for every application, including an *explosion-proof* series for hazardous locations.

Write for detailed literature.

QUELARC* heavy duty circuit breaking series. 2, 3, and 4-pole. Rating up to 200 amperes.

TRIPLOC* multiple-pole series. 1, 2, 3, 4, 6, 8, and 12-pole interchangeable and reversible contact units. 2, 3, and 4-gang units for up to 48 poles.

Sold nationally through electrical distributors

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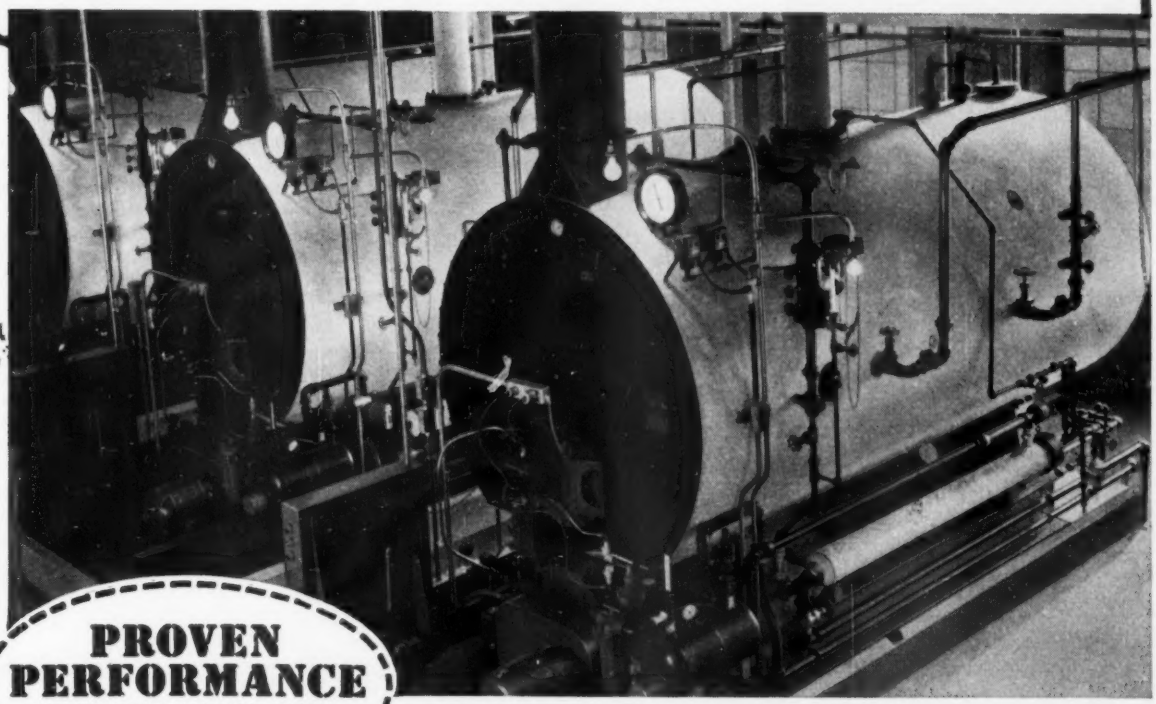
PYLET CONDUIT FITTINGS • FLOODLIGHTS

Cleaver-Brooks boilers save $25,000 per year for Hoosac Mills...pay for themselves in 2 years' time!



PROVEN PERFORMANCE

ANOTHER OUTSTANDING REPORT FROM A CLEAVER-BROOKS OWNER

After installation and starting service was completed, a check was made on boiler output. Tests indicated efficiency exceeded the guaranteed 80%. After eight months' operation without tube cleaning, stack temperature showed no noticeable gain, indicating high efficiency had been maintained. *Planned and installed by Frank I. Rounds Co., Newton Highland, Mass.*

INSTALLING 3 Cleaver-Brooks self-contained boilers at Hoosac Textile Mills, New Bedford Division, was a major step in ending boiler worries. Hoosac can count on yearly savings of $25,000, and they're set up for future expansion as well.

Before deciding what type of boilers to install for replacing old, hand-fired boilers, Hoosac carefully considered these factors:

1. **Efficiency of steam generation** — the cost for supplying 12,000 lbs. of steam required each hour at peak capacity for heating and processing.
2. **Saving labor costs** — through safe, automatic operation.
3. **Cleanliness** — important to textile manufacture.

A study of past performance and prominence of similar units in the industry — showed that Cleaver-Brooks self-contained boilers would fill the bill.

Guaranteed 80% thermal efficiency was one of many influencing factors in selecting the 3 Cleaver-Brooks 150 hp. boilers. Even with loads as low as 30% of rating, these boilers operate with a flat 80% efficiency. (Hoosac operates their plant over widely fluctuating loads, particularly in summer.)

That they attained their objectives is borne out by these results — *results which showed the boilers paid for themselves in 2 years' time.*

1. **$15,000 savings in fuel** — fuel cost studies showed 275,000 gals. of oil at 5½¢ per gal. provide steam for a year's operation. Same steam formerly required 2,000 long tons of coal at $15.00 per ton.
2. **$10,000 savings in labor costs** — fully automatic operation minimized boiler maintenance. Personnel were then available for productive plant work.
3. **Cleanliness** — modern boiler room proved more efficient than previous cluttered arrangement. Hand firing, removal and disposal of fly-ash was eliminated.

In addition to these substantial savings, the installation provided for economical future plant expansion. At present, boiler operation is rotated so all three periodically receive the same service and maintenance.

Cleaver-Brooks boilers are showing similar savings in many other businesses. Investigate — write for Catalog AD-100 and complete information on standard size oil, gas, combination oil/gas fired Cleaver-Brooks boilers, 15 to 500 hp., 15 to 250 psi.

CLEAVER-BROOKS COMPANY
Dept. G, 301 E. Keefe Ave.,
Milwaukee 12, Wis., U.S.A.

Cleaver-Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment
Oil and Gas Fired Conversion Burners

Why This R-P&C Valve Suits the Power Industry

• This cast steel R-P&C Gate Valve with pressure sealed bonnet provides continuous tightness when exposed to the varying conditions of high pressure steam generation. The inside bonnet is forced against a metal sealing ring by pressure in the valve. A compensating wedge permits easy opening and closing by either hand or electric power. This valve is always tight, yet easy to operate.

Cast steel construction is designed for pressures to 1500 lbs., temperatures to 1100° F. Sizes: Gates 2½" to 14"; Globes 2½" to 8". Full specifications are shown on page 144 of the No. 9 R-P&C Valve catalog.

See your R-P&C distributor or write our Reading, Pa., office for information

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

HYDRAULIC GOVERNORS

Continued from page 232

valve has permitted the receiving piston to gradually return to its original position, in the same time the engine took to return to its original speed and the ballarms to return to the vertical.

Note that in this governor the temporary speed droop (compensation) is applied by changing the effective length of the connection between the speeder rod and pilot valve. Changing connection length causes speed droop for the same reason that changing the compression of the speeder spring does, POWER, March, p 73. Each method of causing speed droop changes the engine speed at which the pilot valve seals the control ports.

Strictly speaking, only isochronous governors are true *constant-speed* governors. All mechanical governors, and some hydraulic governors, have permanent speed droop and are "nonisochronous" because engine steady speed is slightly different at different loads. But the speed change from full load to no load (speed regulation) is usually only 3 to 8%. Since such governors hold engine steady speed substantially constant, they too are classed as constant-speed governors.

FEED PUMP

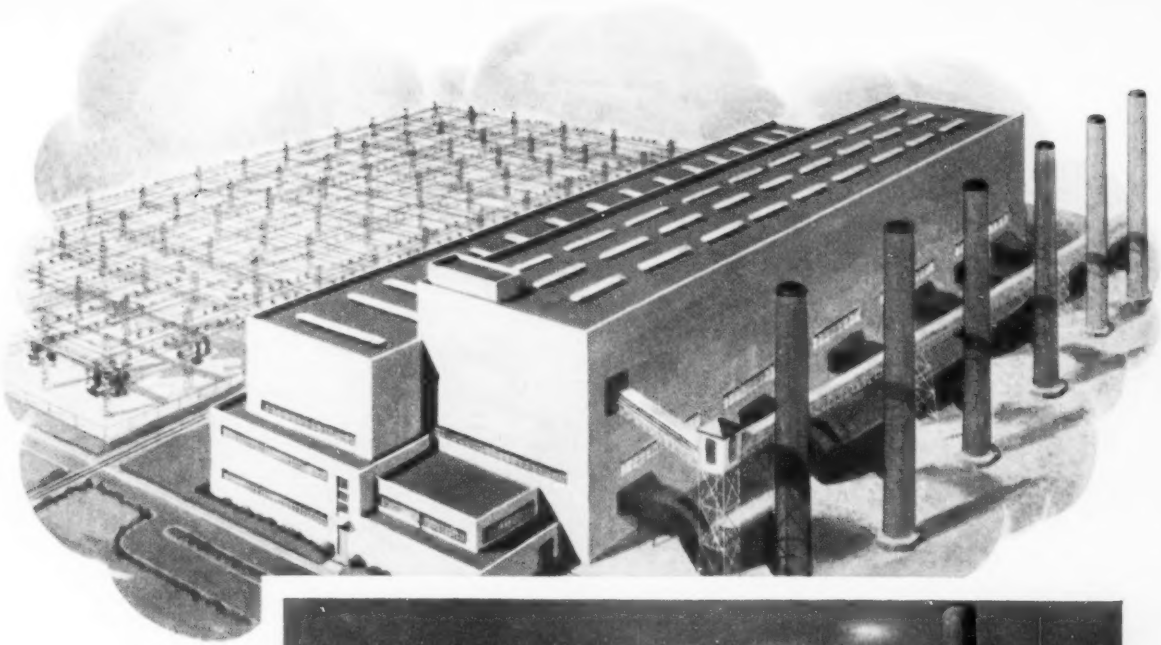
Continued from page 117

cast-iron plungers for high feedwater temperatures. Though cast iron corrodes faster, it's cheaper and easier to replace, and may cost less in the long run.

Commonest liquid-piston packing is fibrous type of laminated layers of duck with a rubber or neoprene binder. It is *soft* or *rockhard*, depending on cure of binder. I find soft grade is good for water to 180 F. Rockhard is used to 240 F. Preformed cups of molded duck and neoprene are easy to install, require no fitting. They are good up to 250 F.

Suction Conditions. Perhaps most headaches with reciprocating feed pumps are from low suction pressures. Even at slow speeds these pumps must have enough suction pressure to overcome friction and to lift suction valve against spring tension. Pressure needed is called *net positive suction head* (npsh). This varies with each size and pump type, with different capacities, and with different sizes and types of liquid valves and springs.

Let's say pump engineer advises 3.5-psi npsh for your capacity. This means pressure in suction line *at pump* must be at least 3.5 psi greater than liquid's vapor pressure at suction temperature. You can provide npsh in many ways—by having water supply above pump suc-



Portsmouth Power Station is designed for an ultimate total of six units, each of 100,000 kilowatt nameplate capacity

More Kilowatts for a Growing Region

The system-wide generating capacity of Virginia Electric and Power Company was increased to nearly 1,000,000 kilowatts early in 1953 and in 1954 it will be further augmented by an additional unit of the Portsmouth Power Station near Portsmouth, Virginia.

The initial unit of this new station, a 100,000 kw preferred standard machine, is already "on the line".

Stone & Webster Engineering Corporation was retained for the design and construction of the new facilities.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

The TERRY TURBINE

TURBINES FOR *Air Conditioning* AT MADISON SQUARE GARDEN

In 1925 Madison Square Garden installed three Terry Multi-Stage Turbines to drive air conditioning and refrigeration compressors. These units deliver 290 hp at 3500 rpm with steam conditions of 100 psi exhausting to a 26 in. vacuum.

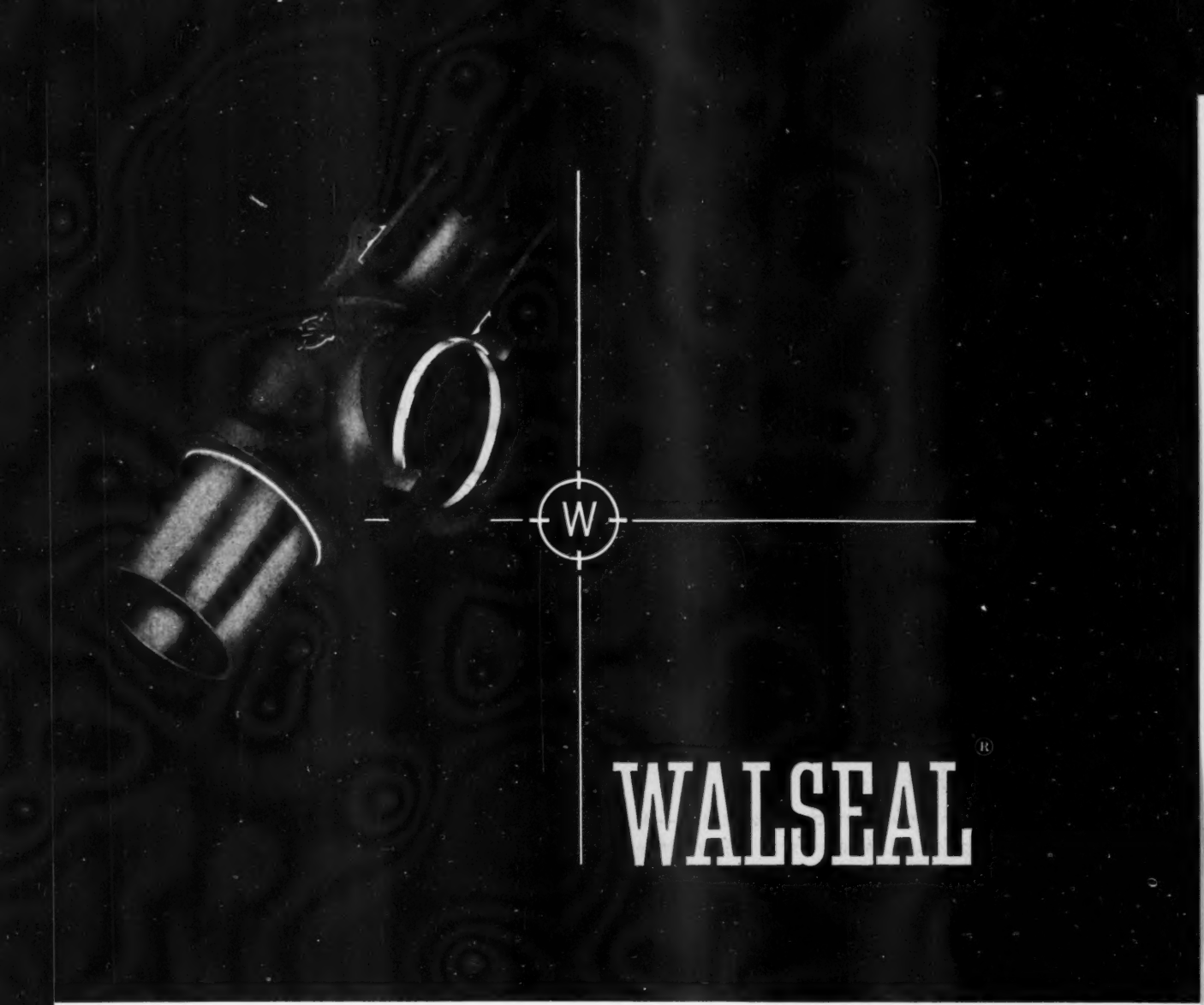
After 22 years experience Madison Square Garden installed three more Terry Multi-Stage Turbines, one of which is shown above. This unit delivers 330 hp, at 5650 rpm, with steam at 100 psi exhausting to a 25 in. vacuum.

The same engineering talent and manufacturing facilities that produced these turbines are available to assist you in obtaining efficient power generation.

Any of our District Representatives will be pleased to give you full information on a turbine drive for your requirements. No obligation. May we send you descriptive bulletin?

TT 1184

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

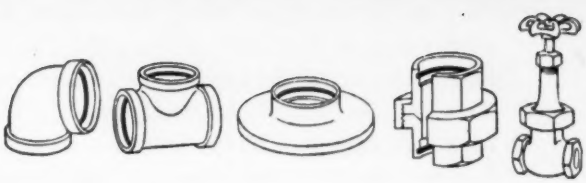


WALSEAL®

COMPLETE LINES OF WALSEAL VALVES AND FITTINGS

WALSEAL is a smooth-bore, bronze valve or pipe fitting having a **factory-inserted** ring of silver brazing alloy in the outlet or outlets. The brazed joint that results when a Walseal product is installed is leakproof, vibration-proof, and corrosion resistant. The alloy fillet that appears upon completion of the joint is visual assurance of **full penetration of alloy.** This improved method of joining brass, copper, or copper-nickel pipe or tube is another Walworth contribution to the progress of the valve and fittings industries.

In addition to its complete line of Walseal products, the Walworth Company manufactures complete lines of valves, fittings, unions, and flanges in a wide range of sizes and temperature-pressure ratings. The company also makes three lines of pipe wrenches, the Genuine Stillson, Walco, and Parmelee. Walworth products total approximately 50,000 items and are sold through distributors or agents in all parts of the world.



The sectioned Walseal tee illustrated, shows: (a) the fillet of alloy that appears upon completion of the Walseal joint. This fillet is your visual assurance of complete penetration. (b) the factory-inserted ring of silver brazing alloy. (c) sectioned view of the completed Walseal joint showing penetration of alloy both ways from the insert. Walseal joints can be made only with Walseal valves or fittings. For further details regarding Walseal products, ask for Circular 84.

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valves . . . fittings . . . pipe wrenches

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DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

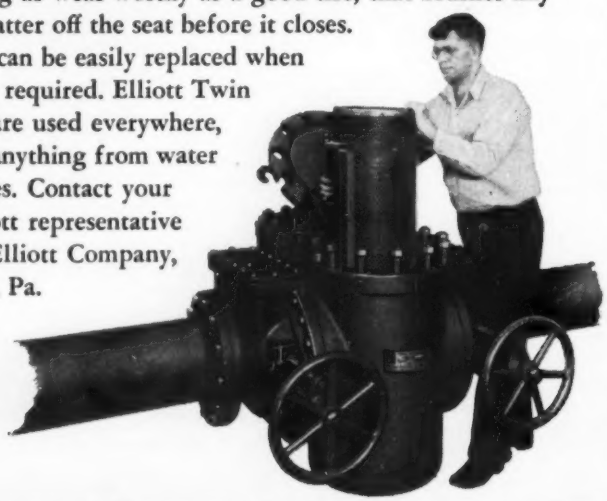
There's no "do it now" about cleaning an

ELLIOTT TWIN STRAINER

No need to interrupt some vital maintenance job to dump the fouled basket on one of these non-stop straining units. The alternate basket will take on the job with the turn of a couple of handwheels, cutting out the fouled basket for attention any convenient time within a reasonable period.

Not that cleaning is so much a job. It isn't—all that's necessary is to back off the cover nuts a few turns, spin out the washers, lift the cover, pull out the basket, dump it, and reverse the process. That basket is open at the top, too, for easy dumping. No fussing to get out the trapped trash.

TWIN STRAINERS have a number of features to help them keep on the job. Valve discs, for instance, have an inserted rubber ring as wear-worthy as a good tire, that brushes any foreign matter off the seat before it closes. This ring can be easily replaced when ultimately required. Elliott Twin Strainers are used everywhere, handling anything from water to molasses. Contact your local Elliott representative or write Elliott Company, Jeannette, Pa.



ELLIOTT Company

Accessories Dept.

A3-2

FEED PUMP

Continued from page 234

tion, with a booster pump, etc, but you must have npsh if pump is to run properly. Low npsh causes pounding and excessive pump-valve wear, flashing in pump, and capacity loss with possible complete flow stoppage.

Some jobs have suction supply open to atmosphere if feedwater is below boiling point at atmospheric pressure. Difference between water's vapor pressure and atmospheric pressure helps push liquid into pump. In a closed system, pressure of the water vapor on liquid's surface equals the vapor pressure of the liquid itself.

To move liquid to pump takes static elevation or a booster pump. Most steam pumps on closed systems run well with 8- to 12-ft static head above vapor pressure on suction. Friction loss in long, small-diameter lines reduces npsh at pump.

Controls. Another advantage of direct-acting pumps is that all controls may be steam operated. Most widely used control for boiler feed is excess- or differential-type pressure governor.

Remember, boiler pressure usually varies somewhat. If your governor is set to maintain a fixed discharge pressure of 240 psi for a boiler pressure of 200 psi, the 240-psi discharge may not force water into boiler if pressure rises to, say, 225 psi. Simple solution is the governor, Fig. 4.

Throttle-type valve is installed in steam line to pump. Valve connects through a stem to diaphragm at top. Boiler pressure is piped to one side of diaphragm, pump discharge to the other. Diaphragm measures difference between boiler and pump discharge pressure. Difference is counterbalanced by spring load on valve stem.

Spring-tension variation, to counteract diaphragm load, controls position of steam throttle valve to give any desired differential pressure on pump's liquid end. Fig. 5 and 6 show typical differential-pressure governor installations.

Feedwater-level controls are common. Steam-throttle valve is simply opened or closed with variations in boiler-water level. Float controls valve setting so pump provides needed feedwater. Constant-pump-speed governors have little application in boiler feed service.

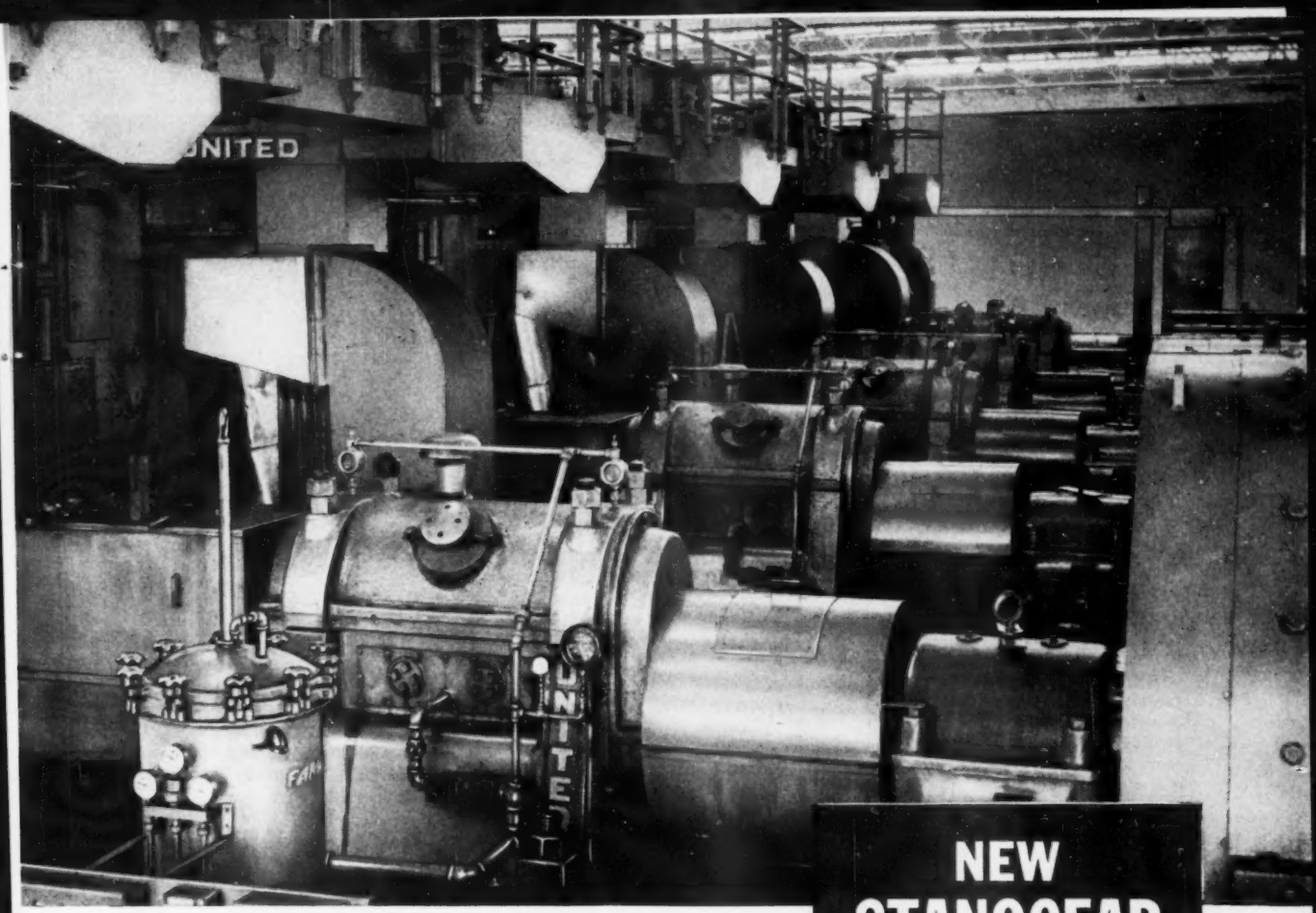
313 ITEMS

Continued from page 81

16 Conductivity meter cells have proper constants for normal conductivity range to be measured.

17 Deaerator level indicator of recording type specified.

(*Continued on page 210*)



NEW STANOGEAR
REG. U. S. PAT. OFF.
Compounds

NOW . . . 7 ways better for extreme-pressure lubrication . . .

New and improved STANOGEAR Compounds have been developed to meet the requirements of an increasing variety of tougher extreme-pressure lubricating jobs found throughout industry, today. The result of several years of special research and field test work, these outstanding products have proved in actual service their ability to provide these important advantages:

1. Higher load carrying capacity. Use of improved extreme-pressure additives in STANOGEAR Compounds provide a greater anti-weld property. This results in the higher load carrying capacity which these products have demonstrated in actual service.

2. Superior retention of load carrying capacity. In service tests, STANOGEAR Compounds have proved superior to conventional extreme-pressure lubricants in ability to maintain a high load carrying capacity over extended periods of service.

3. Freedom from objectionable deposits. Appropriate base stocks and additives give STANOGEAR Compounds a high resistance to oxidation, thus minimize the formation of deposits.

4. Excellent storage stability. STANOGEAR Compounds contain compounding ingredients which assure excellent stability both in service and storage.

5. Good water separation. STANOGEAR Compounds have demonstrated their superiority to ordinary extreme-pressure lubricants in ability to provide good water separation.

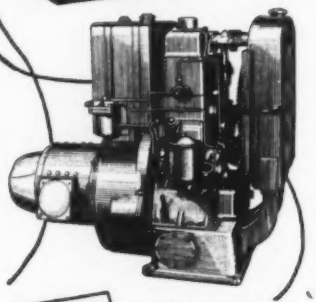
6. Anti-foaming. Under adverse operating conditions, the anti-foam agent in STANOGEAR Compounds has prevented foaming troubles.

7. Versatility. A unique combination of additives in STANOGEAR Compounds equips these products for various industrial gear applications where extreme-pressure lubricating properties are necessary. To meet varying viscosity requirements, STANOGEAR Compounds are available in eight viscosity grades.

The Standard lubrication specialist in your area of the Midwest will be glad to give you more information about the new STANOGEAR Compounds. You need only phone your local Standard Oil office. Or write: Standard Oil Co., 910 South Michigan Avenue, Chicago 80, Illinois

STANDARD OIL COMPANY STANDARD *(Indiana)*

You get more for your money with NORDBERG DIESELS



COST LESS TO OPERATE

In addition to the low initial cost of the 1, 2 and 3-cylinder Nordberg "4FS" series Diesel engines, the outstanding design and construction of these compact units assures extremely low fuel and lube oil consumption . . . which has been proved in a wide range of power jobs.

MORE 'EXTRAS'

Here are the "extras" that are all *included* in the low initial cost of Nordberg Diesel units: thermostatically controlled cooling system — heavy duty oil bath air cleaner — lube oil cooler — fuel and lube oil filters. *Compare* before you buy *any* 10 to 45 hp engine.

LONGER LIFE

Like all Nordberg Diesels, the "4FS" series engines are sturdily built to give years of reliable service with a minimum of maintenance time and expense.

Clip the coupon for details on Nordberg Diesel power units from 10 to 45 hp—Diesel generator units from 6 to 30 kw—or for Diesel pumping units in capacities from 200 to 3000 gpm at 15 to 240 ft. total head.

NORDBERG MFG. CO., Milwaukee, Wis.

NORDBERG

BUILDERS OF AMERICA'S LARGEST LINE OF HEAVY DUTY DIESELS

MAIL THIS COUPON TODAY

Nordberg Mfg. Co., Milwaukee, Wis.

Send catalog covering Nordberg Type 4FS Diesels. I am interested in a unit for the following service: PM

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Your Name.....

Company Name .....

Address .....

City..... Zone.... State....

4-553

313 ITEMS

Continued from page 238

18 Condensate flowmeter of recording type specified.
19 Tear-off device for strip-chart-type recorders.
20 Important recording meters have alarm contacts for warning.
21 Capillary and instrument-air tubing protected from damage.
22 Air compressors sized for not more than 50% operating time with all air-using equipment running.
23 Emergency or reserve air or oil supply for control equipment.
24 Low air-pressure alarm.
25 Controls lock or move to safe position in case of air failure.
26 Manual operating levers and locking clamps for all controlled equipment.
27 Controls grouped with corresponding instruments on boards for operating convenience.
28 Most-frequently-read meters near eye height on control boards.
29 Air supply and control piping accessible for checking leaks.
30 Adequate room around and above equipment at rear of control boards for maintenance and water-column calibration.
31 Protection of control-board electrical equipment from water leaks or spillage.
32 Thermostat element located well below desuperheater to get good steam-water mixing.
33 ASME-type sampling nozzles for evaporator vapor and other desired sampling points.
34 Tees and cleanout plugs on boiler draft lines, other points.
35 Orsat gas analyzer, extra chemicals, spare parts, small amount of mercury on hand.
36 Line pressure-tap connections at least ½ in. in size.

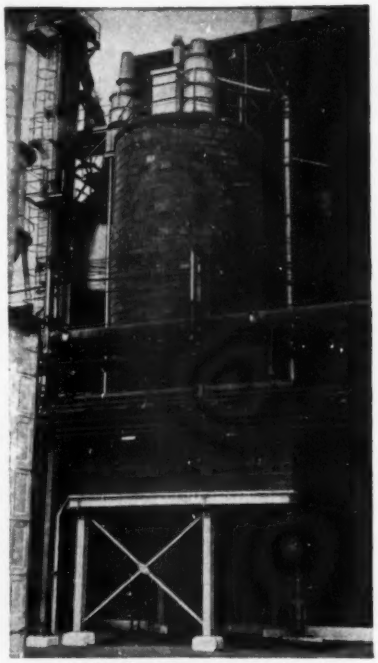
More POWER NEWS

Begins on page 150

The six members present at the conference were: Albert L Baker, chairman of Vitro Corp and Vitro Mfg Co (who presided); Walker L Cisler, president, The Detroit Edison Co; Dr T Keith Glennan, president, Case Institute of Technology; Alfred Iddles, president, The Babcock & Wilcox Co; John R Menke, president, Nuclear Development Associates; and Admiral Earle W Mills, president, Foster-Wheeler Corp.

Engineering Enrollment Climbs

An almost unprecedented increase in the number of freshmen engineering students enrolled in 1952, tops by 30.5% the number for the previous year. The 51,631 new students entering in the fall of 1952 represent the third largest class ever to enter the engineer-



A "National" installation for American Cyanamid Co. plant at Bridgeville, Pa.

ASH REMOVAL the NATIONAL way assures you low-cost, dependable service

Are ash removal costs a factor in cutting your profits? We suggest a survey by a National engineer. It will cost you nothing. It may avoid wasted dollars.

NATIONAL PNEUMATIC STEAM ASH REMOVAL SYSTEMS

save money in two ways—

1. Exceptionally easy one-man operation cuts labor cost to the bone.
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A complete and effective service policy and a reputation for delivering satisfaction are extras that go with NATIONAL installations.

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Manufacturers of The National ChipVeyor System For Metal Turnings—Furnace Doors—Feeders—Ash Gates and Related Equipment.

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STARTS WHERE NATURE STOPS

AT PENNSYLVANIA ELECTRIC CO.
IT'S A COCHRANE DEMINERALIZER

Cochrane Demineralizer Installation at Pennsylvania Electric Co., Erie, Pa.— Gilbert Associates, Inc., Engineers, Reading, Pa.

• To supply high quality water for boilers operating at 1250 P.S.I.G. the Pennsylvania Electric Company installed a Cochrane Automatic Demineralizer in their Erie, Pa. Power Station. Designed for silica removal, this unit handles 400 GPM in preparing make-up for the boilers.

Demineralization is one of many "water problems" Cochrane's engineers solve every day. Water softening, dealkalization, and deaeration are others—all complex—all requiring expert and specialized knowledge. Whether for process or boiler feed water Cochrane can supply the answer to your particular problem, backed by 90 years' experience in solving industrial water conditioning problems. You'll be sure of unbiased recommendations because Cochrane designs and builds all types of water conditioning equipment.

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In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris

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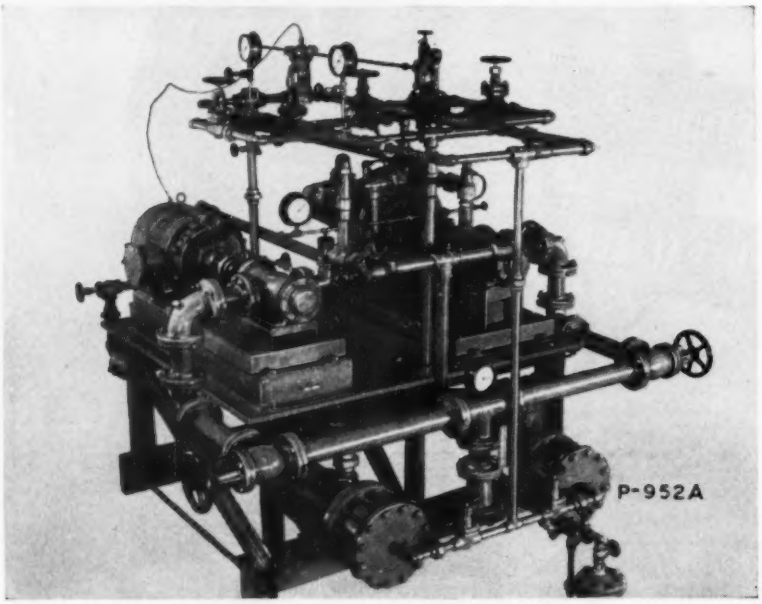

P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-E52H size No. 25 unit.

NATIONAL AIROIL
FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40 — very interesting and informative.

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OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
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FUEL OIL PUMPING and HEATING UNITS
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More POWER NEWS

Begins on page 150

ing schools. The figure is topped only by the postwar years of 1946 and 1947. Assuming normal progression, the resulting number of graduates in 1956 will be in the neighborhood of 30,000. The outlook for the years 1953-56, however, shows little relief in the acute engineering manpower shortage.

Coming Events

June 9-12—National District Heating Assn, 44th Annual Meeting, Lookout Mountain Hotel, Lookout Mountain, Tenn.

June 15-19—American Institute of Electrical Engineers, summer general meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. AIEE, 39 W 39th St, New York 18, N. Y.

June 16-19—American Welding Society, spring technical meeting, Shamrock Hotel, Houston, Texas. AWS, Suite 1006, 12 E 41st St, New York 17, N. Y.

June 29-July 3—American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. J W Sifton, ASTM, 1916 Race St, Philadelphia 3, Pa.

July 20-22—Fourth Diesel Power Plant Conference, Iowa State College.

Sept 1-4—American Institute of Electrical Engineers, Pacific General Meeting, Hotel Vancouver, Vancouver, B. C.

International Boiler Code

First formal meeting of a committee to work on an international boiler code was held in Paris, May 12-20. Both American and European manufacturers have been concerned over increasing difficulties in having high-pressure high-temperature boilers accepted in countries where there are no boiler laws at all and such matters are subject to the whims of government officials.

Such international standards matters come under the jurisdiction of the International Standards Organization (ISO), which is composed of representatives of national standards societies from most of the world's countries. American Standards Assn (ASA) is the U. S. representative in ISO and normally acts as secretariat for American standardization projects. Because of the world-wide prestige of ASME's code, its Boiler Code Committee was asked by the other nations to accept the secretariat of this international code project, known as ISO/TC-11.

In 1951, informal meetings were held with representatives of British Standards Institution (BSI) to see if the world's

Homocord Conveyor Belt—More use per dollar

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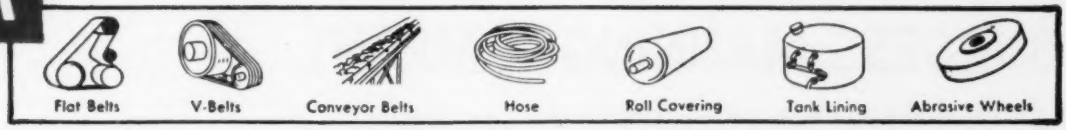
MORE SHOCK-LOAD CUSHIONING . . . The extra body-cushion built into Homocord Conveyor Belt dissipates even the shock of sharp impact from large lumps of coal, rock and ore . . . A Homocord Conveyor Belt resists gouging and cutting. It lasts longer . . . and hauls more too—because it troughs naturally and trains easily in the idlers. That's MORE USE PER DOLLAR. Another R/M Conveyor Belt, Ray-Man "F", is designed particularly for underground mining where pulleys are small and great flexibility and tear resistance are needed. Both of these R/M belts give you long life on the job, MORE USE PER DOLLAR. Ask the R/M distributor for Bulletins 6906 and 6915. R/M field engineers back him up to save you money—not only in conveyor belts, but in hose, transmission and V-belts.

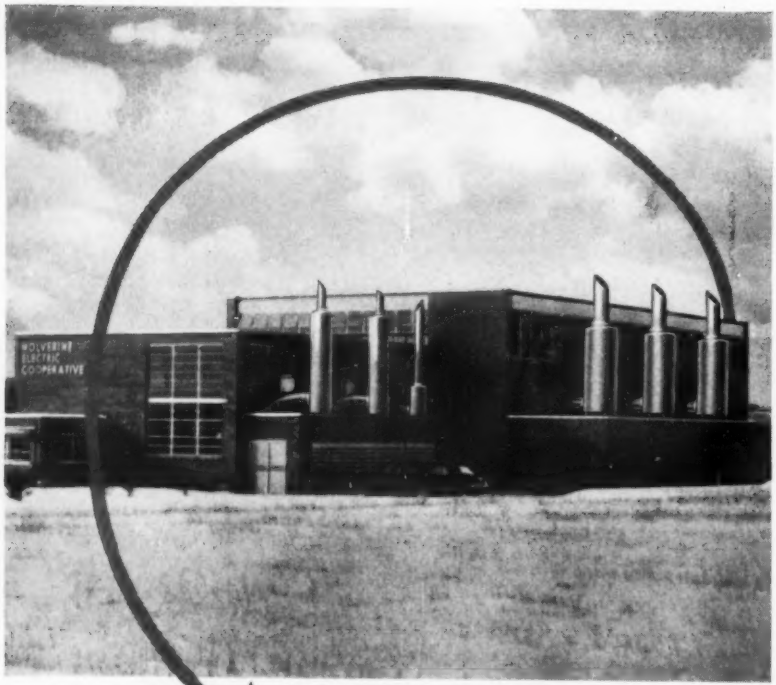
R/M

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls



Fairbanks, Morse and Company and Cooper-Bessemer Corporation Diesels, equipped with exhaust Snubbers.

Sound Engineering

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*Typical Snubber

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749-J East Park Avenue, LIBERTYVILLE, ILLINOIS

Chicago Dallas

More POWER NEWS

Begins on page 150

two leading boiler-making nations could find sufficient areas of agreement to work up an international code which would serve as a "floor" under ASME and British codes. Then a boiler built to either code would be acceptable under an international code. Subcommittees prepared a draft, which was circulated to member nations.

American delegates to the Paris meeting, which continued this work, were: Dr E O Bergman, consulting engr, C F Braun & Co; F X Gilg, application engr, Babcock & Wilcox Co; H H Hemenway, chief engr, steam division, Foster Wheeler Corp; C O Meyers, secretary, National Board of Pressure Vessel Inspectors; Dr H B Oatley, chairman, ASME Boiler Code Committee; D L Royer, chief engr, Ocean Accident and Guarantee Corp; J L Menson, design engr, Combustion Engineering - Superheater, Inc; C W Wheatley, asst to president, A O Smith Corp. Mr Menson served as alternate for A C Weigel. The delegation was headed by F X Gilg.

Distribution transformers with aluminum windings can be built with approximately the same characteristics as the present copper designs, Raymond W Smith, general manager of the **General Electric Co's** Distribution Transformer Department, announced. In spite of the lower conductivity of aluminum and increased manufacturing problems, distribution transformers in a number of ratings have been produced using aluminum windings with the over-all weight, dimensions and electrical characteristics practically identical to copper transformers, he added.

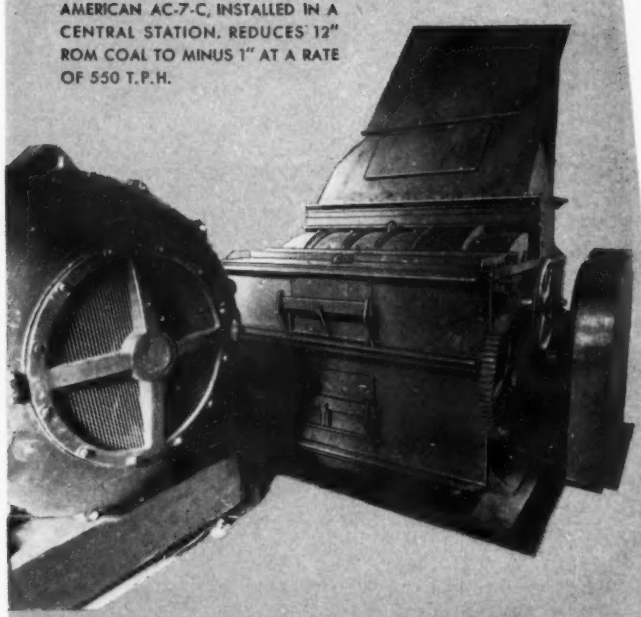
The company does not plan to shift to the use of aluminum at this time, Smith emphasized. However, several hundred development and production transformers with aluminum windings have been built in sizes 5 to 333 kva for voltage classes of 15,000 volts and less. Many of these transformers are now operating on customer's lines and plans are to continue a small experimental production.

Despite current forecasts of commercial atomic power within five years, one of the nation's top atomic power experts predicted today that it would be 15 years or possibly double that time before atomic power plants will compete on a sound basis with coal, oil or gas-fired plants. And don't expect atomic electrical power at unbelievably low costs, Harry A Winne, **General Electric Co** vice-president of engineering, advised the Diamond Jubilee Convocation at Case Institute of Technology.

Mr Winne said large atomic-electric power stations are possible within five years—if someone wants to pay for them and their operation, but he cited the terrific cost if they are built on the cash basis. In terms of developing an industry Mr Winne put atomic electric power 15 to 30 years in the future.

More POWER NEWS on page 266

Check *American* Quality—Feature by Feature—and you'll know



AMERICAN AC-7-C, INSTALLED IN A CENTRAL STATION, REDUCES 12" ROM COAL TO MINUS 1" AT A RATE OF 550 T.P.H.

WHY AMERICAN CRUSHERS can reduce coal for less than

per ton

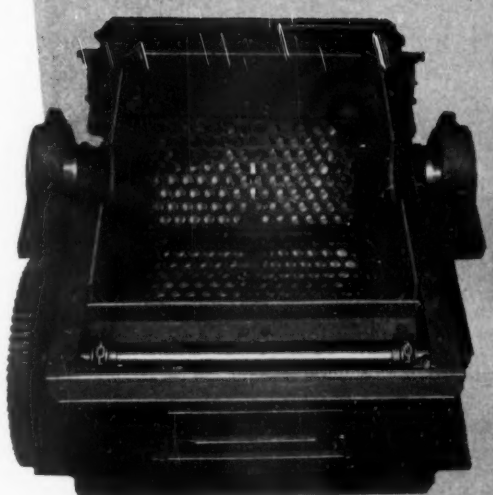
AMERICAN Feature No. 3

COMPLETELY LINED CRUSHING CHAMBER

LOOK INSIDE—before you decide on a crusher. There's the place to check for unstinted quality—the place to look for future performance potential.

Look inside an AMERICAN CRUSHER. There, for example, you'll find the American-designed chamber liner — thick punish-taking plates which completely line the crushing chamber . . . sectional for easy plate-at-a-time replacement . . . engineered to offer *lifetime* protection to the vital frame and housing structures.

This liner, plus the all-manganese steel shredder rings, breaker plate and grinding plate explain why the rugged work area of every American Crusher operates on such low maintenance costs . . . why Americans stay on the job year after year—as top performers!



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For want of a packing a seal was lost.
For want of a seal a machine was lost.
For want of a machine an order was lost.
For want of an order a business was lost.

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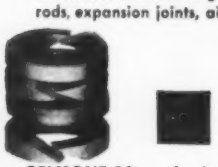
Incredible? Ask any hard-pressed manufacturer or service organization faced with costly, delaying—even crippling—maintenance shutdowns. Just the bare *chance* that it could happen to you is good and sufficient reason to pay for the best and make sure you *get* it by working with one experienced, reliable distributor—your BELMONT distributor—on all your packing and gasketing requirements.

Don't wait upon sad experience to teach you the vital importance of proper selection and application of packing materials. Call your BELMONT distributor today. Or, write on your company letterhead for Belmont catalog.

BELMONT 9 . . . for all hydraulic services from low pressures to extremely heavy duty, hot and cold water.

BELMONT 30 . . . for high pressure steam rods, expansion joints, air, and gas.



BELMONT 19 . . . for hot and cold water rods and plungers; low and intermediate steam rods.

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Acids • Alkalies • Ammonia

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BOOKSHELF

PLANT LOCATION. *(1952). By Leonard C Yaseen, senior partner, Fantus Factory Locating Service. 195 pp, 8½ x 11, photos, maps, loose-leaf, $12.50. Business Reports, Inc, 225 W 34 St, N. Y. 1, N. Y.*

This study should be most useful to any engineer or businessman concerned with locating a new plant. Text, pictures and many charts give useful information on various steps, and remind the reader of factors that must be considered.

Chapters cover plant location; transportation; raw materials, sources and markets; labor availability; labor costs and stability; power, fuel and water; taxes and labor laws; climate; final analysis of communities; selecting the site; hints for industrial development groups; bibliography.

Since power engineers are likely to be called in on the power, fuel and water aspects of plant location, they will be particularly interested in the 22 pages devoted to these subjects. In general, the power-fuel-water material seems to be well handled. However, we would suggest to the publishers that they make two corrections in future issues. On page 76 it is stated that it takes 6000 gallons of water to generate one kwh. This figure is impossibly high.

On page 77 it is suggested that cubic feet be converted into gallons by multiplying by 7.480512. This suggestion will not appeal to practical engineers who would never use more digits than 7.48. In fact, the accuracy of this type of study would hardly justify anything beyond 7.5 gal per cu ft.

WHAT'S INSIDE OF ENGINES? *(1953). By Dr. Herbert S Zim, Assoc Prof of Education, University of Illinois. 32 pp, heavily illustrated, including end papers, $1.75. William Morrow & Co. Inc, 425 Fourth Ave, New York 16, N. Y.*

If your youngsters ask questions you find it hard to answer in easy-to-understand terms, this attractive little book will do it for you. Dr Zim, scientist and educator, shows clearly and entertainingly how the various kinds of engines operate—steam, gasoline and diesel engines, steam and gas turbines. He even tackles those modern wonders, rockets and atomic piles.

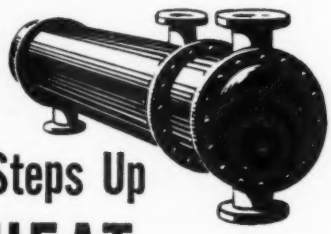
Each gets a clear explanation in large type, followed by a smaller-type section that fills in additional details that may be wanted by an inquiring youngster. Excellent illustrations in color, by Raymond Perlman, show general construction and operating principles.

One of the Morrow Junior Books, this little volume is the fourth in a new series begun last Fall.

ELECTRIC CONTROL SYSTEMS. *(Third Edition). By Richard W Jones, Professor of Electrical Engrg, Northwestern Technological Institute. 511 pp, $7.75, 9½ x 6, John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This book was written assuming the reader has had the normal undergraduate

How Safe Chemical Cleaning



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If your heat exchangers are sludge-bound or scale-clogged—try this widely-used Oakite chemical cleaning method. Circulate recommended solution of specially formulated Oakite sludge-remover or lime scale-dissolver.

This performance-proved Oakite remedy eliminates expensive, time consuming equipment dismantling and re-assembly. Eliminates, too, the potential dangers usually associated with manual rodding.

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...with TYCOL lubricants on hand!

Top this record! A well known utility company has operated a turbine for *almost 12 years* without an oil change or cleaning. At a rate of less than 10% "make-up" per year, Tycol Aturbrio has served the plant without malfunction – for years on end. And Tycol Aturbrio performance records show turbine after turbine running well over 100,000 hours without a change! That's *proven stability* . . . further substantiated by the regular use of Aturbrio as an outstanding hydraulic oil. Full data on Aturbrio performance is available from your local Tide Water Associated office.

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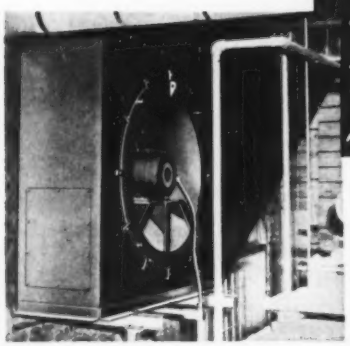
The WING Package—
DRAFT INDUCER
FOR POWER PLANTS



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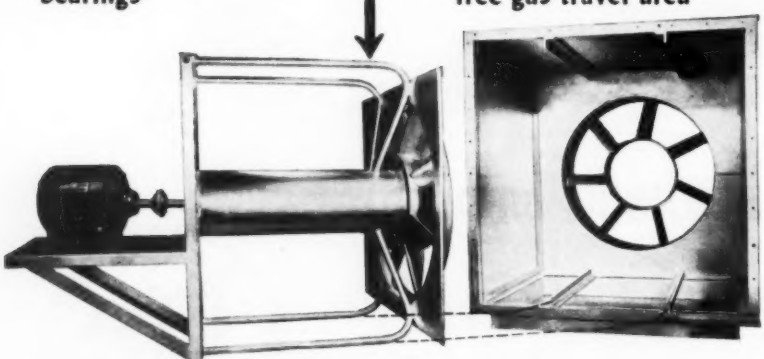
In this new high-pressure "Package" Draft Inducer, the motor (or turbine) and fan unit, completely independent of the casing, makes installation considerably easier, and being easily removed, facilitates inspection and maintenance.

ADVANTAGES

1. Big saving in space requirements
2. Compactness permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two supporting bearings
6. Wide flexibility in gas inlets
7. All moving parts quickly and easily accessible
8. Saves on investment and maintenance
9. Low load ratings on natural draft because of Wingfoil Fan and ample free gas travel area



Wing Package Draft Inducers are available in many sizes with either turbine or electric motor drive. For further information write

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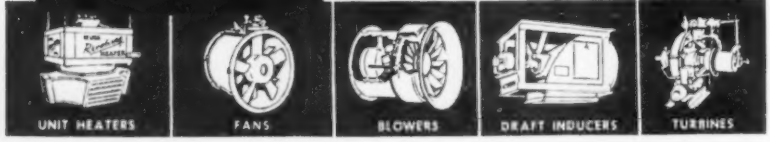
L. J. Wing Mfg. Co.
50 Vreeland Mills Road,
Linden, New Jersey
FACTORIES: Linden, N.J. and Montreal, Can.



More BOOKSHELF

Begins on page 246

preparation in circuit theory, electrical machinery, electronics and ordinary linear differential equations. Material is sufficient for one semester of three lectures and one laboratory course each week.

The author has aimed to develop the student's fundamental concepts of relay switching, networks, introducing Boolean algebra for this purpose. Book also considers both relay and counting circuits. The author treats power amplifiers of both the dynamo-electric and magnetic types, developing the concept of transfer functions.

The principles involved in the study of feedback controls are introduced as a natural extension of the study of controllers without feedback. Problems included treat points not covered in text; biblography incorporated.

PRINCIPLES OF ALTERNATING-CURRENT MACHINERY. *(Fourth Edition). By Ralph R. Lawrence, Professor Emeritus of Electrical Machinery, Massachusetts Institute of Technology, and revised by Henry E Richards, Professor of Electrical Machinery, Northeastern University. 9½ x 6, $7.50, 623 pp, McGraw-Hill Book Co, 330 West 42 St, New York 36, N. Y.*

Written for the electrical engineering student, this new edition now contains problems along with the text. It provides a comprehensive analysis of the operation and characteristics of transformers, synchronous generators, synchronous motors, polyphase induction, single-phase induction, series and repulsion motors. Other subjects covered in somewhat less detail are the induction generator, synchronous converter and mercury-arc rectifier.

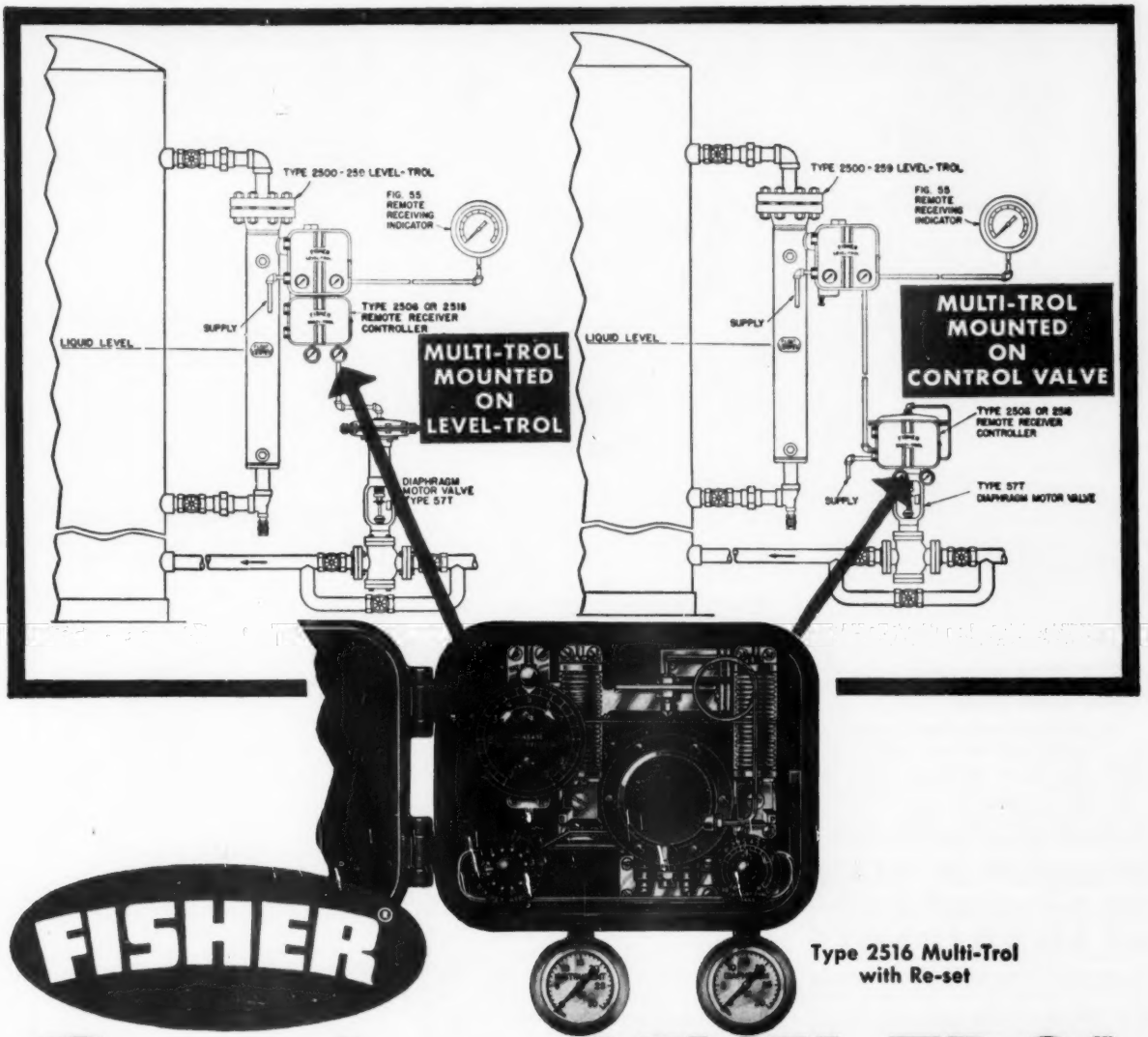
The treatment throughout is strongly analytical, designed to give the student a sound foundation in the way each machine works and the reasons behind special characteristics. True understanding is facilitated by deriving formulas and working equations from basic theory.

The author's approach is through the transformer since the student can gain greater appreciation of generators and motors by first mastering the principles of magnetic induction as applied here.

SYNCHROS SELF-SYNCHRONOUS DEVICES AND ELECTRICAL SERVO-MECHANISMS. *By Leonard R Crow. 222 pp, 9 x 6, $4.20. Scientific Book Publishing Co, Vincennes, Ind.*

One of the aims in preparing a book of this nature is to cover all the important ideas and concepts that are needed for the understanding of self-synchronous control systems. And this the author has done. The book is timely in view of the current increase in use of synchros and self-synchronizing devices by both industry and the armed forces.

The author introduces his subject with a chapter on generalized information on synchros; construction, bearings, position control, etc. From there he steps into field of single-phase synchronous drive devices, the synchro control transformer, differential synchros, helpful experiments and on through magnesyns and other saturable-core electrical servomechanisms.


TYPE 2500 - 250 LEVEL-TROL
FIG. 55 REMOTE RECEIVING INDICATOR
TYPE 2506 OR 2516 REMOTE RECEIVER CONTROLLER
SUPPLY
LIQUID LEVEL
MULTI-TROL MOUNTED ON LEVEL-TROL
DIAPHRAGM MOTOR VALVE TYPE 577
TYPE 2500 - 259 LEVEL-TROL
FIG. 55 REMOTE RECEIVING INDICATOR
MULTI-TROL MOUNTED ON CONTROL VALVE
TYPE 2506 OR 2516 REMOTE RECEIVER CONTROLLER
TYPE 577 DIAPHRAGM MOTOR VALVE
SUPPLY
LIQUID LEVEL

FISHER®

Type 2516 Multi-Trol with Re-set

Dual Control LEVEL-TROL

VERSATILITY OF MOUNTING FOR EASY "ON THE SPOT" ADJUSTMENT

This new Fisher Controller consists of a primary pilot (standard Fisher Series 2500 Level-Trol—used for indicating or controlling level) whose output is transmitted by pneumatic link to secondary pilot—the Multi-Trol.

MULTI-TROL FEATURES

1—Available with reset (Type 2516) or without reset (Type 2506). (Reset may be added to units originally furnished without it.)

2—Proportional band adjustment is incorporated into the remote receiver controller with a range of 10% to 200%.

3—Level control point is adjustable manually in the case by level set adjustment. For remote set—provided with connection for remote air loading.

4—Pressure balanced type of relay provides intermittent bleed and gives accurate stable control.

5—Pilot may be changed from a direct acting to a reverse acting unit or vice versa, thru the use of switch plates.

6—Pilot may also be changed from proportional action to two position action or vice versa, by repositioning a switch plate.

Write for Bulletin F-2506

FISHER GOVERNOR COMPANY, Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

"NO SHUT-DOWNS WITH LUBRIPLATE"

—say HENRY & WRIGHT of Hartford, Conn.

"While waiting for delivery of one of our 25-ton Dieing Machines to do a particularly heavy job, a customer was trying to start production of a 10-ton machine. Even though it was lubricated with a conventional grease every eight minutes, the machine had to be shut down for bearings to cool during each coil run. Then, on our recommendation, he changed to a LUBRIPLATE Lubricant. With but two applications of LUBRIPLATE a day, the machine operated continuously except during change of coils."

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REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

My Biggest Boner

Our shop does many different types of repair jobs. Recently we received a small portable engine-generator set for overhaul. We turned to on it in a hurry and got it back into good shape, after which we ran several tests to check output.

To get the set out of the shop we lifted it off its base with a chain fall attached to rollers on an overhead rail. We rolled the set outside the building to a loading platform and eased it down onto a 2-wheel trailer. My helper put two bolts through holes in the unit's feet to hold it to the trailer.

Just then it started to rain and, since there was no roof over the shipping platform, my helper and I grabbed the trailer hitch and started pulling to get it under cover. We moved about three feet before the trailer stopped with a jerk. Looking back I saw the engine over on its side, almost off the trailer.

We had forgotten to unhook the chain fall and the engine stayed where it was while we pulled the trailer. Luckily, the exhaust pipe caught in the trailer, preventing damage to the distributor and other small parts. But while I held the trailer up and my helper unhooked the hoist, I resolved never again to let excitement make me forget safety on the job. It can cause you plenty of trouble.

W A SMITH *Ilwace, Wash.*

● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

An earth fault in the left abutment of the Folsom Dam project on the American River near Sacramento, Calif., may delay work on the dam for a year or longer, but will not affect construction of the power plant. Spokesmen for the Corps of Engineers, who are building the dam, say the fault is in a "substantial" part of the left abutment, 30 ft below the foundation.

When you're looking for

Full Protection

. . . LOOK TO

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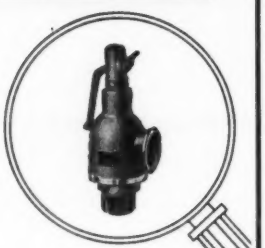
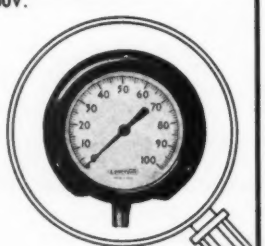


for . . .

SAFETY-RELIEF VALVES

To provide sure protection for boilers, compressers, pumping systems and a wide variety of process equipment . . . equip with Lonergan Safety - Relief Valves. They are modern in design and of rugged construction with a wide selection of types for moderate and high pressures and temperatures. Send for Catalog 800V.



for . . .

PRESSURE GAUGES

There are 28 types and over 100 models to meet a wide range of services. Sizes from 2½" to 12". Exact engineering, modern design and precision movements assure dependability and satisfaction. *Ask for Catalog 800G.*

J. E. LONERGAN CO.

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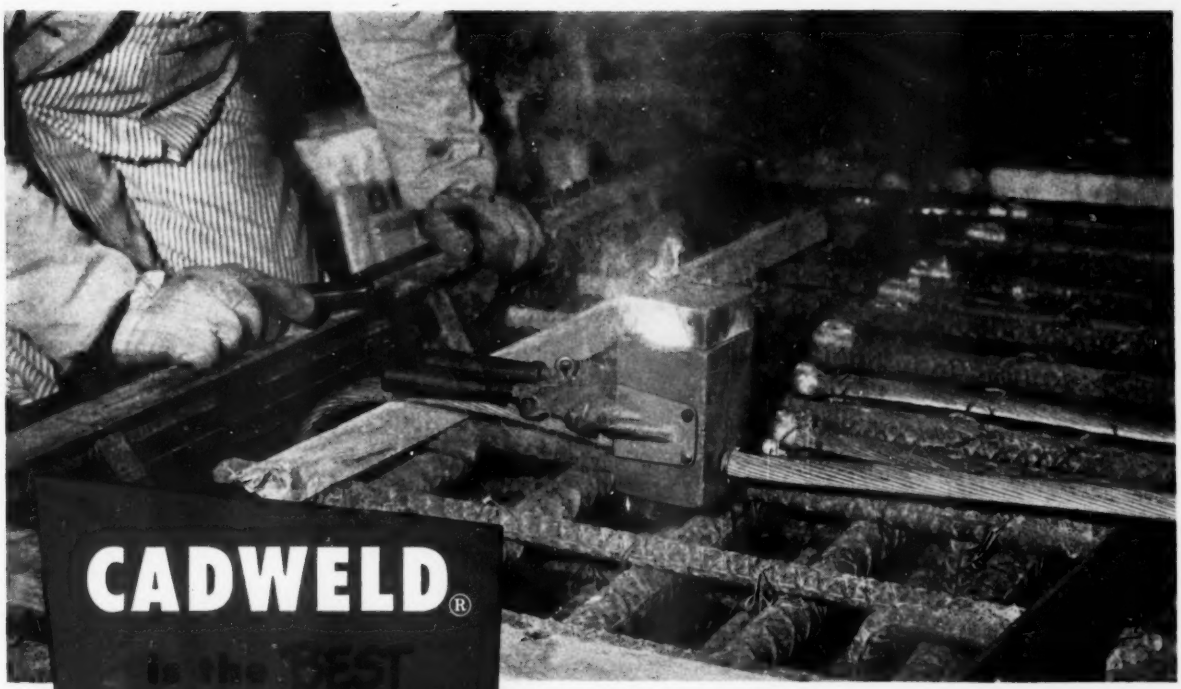


CADWELD®

is the BEST ELECTRICAL CONNECTION

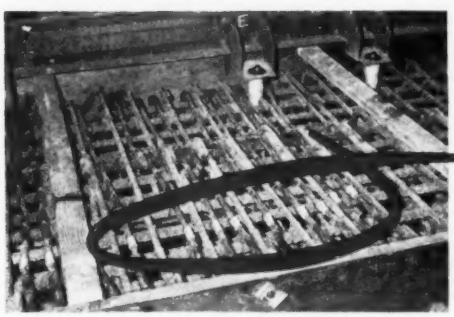
Not only on the surface

For the best in grounding connections—there is only one answer—CADWELD. Regardless of whether the cables are exposed or buried in the earth or concrete, CADWELD gives you the best electrical grounding connection possible.

The solid copper CADWELD CONNECTION has 3 big advantages:

1. **It is permanent**
2. **It cannot loosen or corrode**
3. **It has a current carrying capacity greater than the cable**

In addition CADWELD is ideal for all construction work as it requires no outside source of power and the equipment is lightweight and portable.



500 MCM short circuiting conductors CADWELDED around the reinforcing bars of a large concrete beam. Under the beam will run the generator leads. These cables remove the induced currents in the reinforcing bars that would otherwise produce heat and destroy the concrete.

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CADWELDED straight splice of 500 MCM cable

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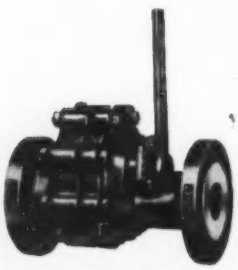
mean "EVERLASTING" PROTECTION on these duties



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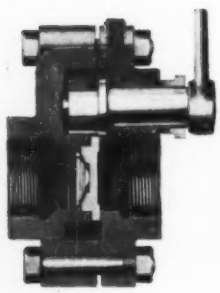
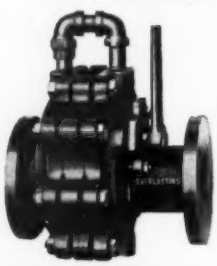
Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.





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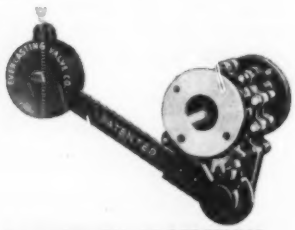
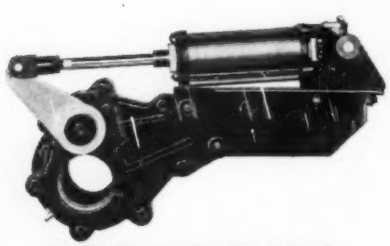
Assure continued free flow of any material which congeals at ordinary temperatures.



EMERGENCY PROTECTION

Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.



CYLINDER-OPERATED VALVE

for accurate control of process work. Straight-through flow, drop-tight seal, air or hydraulic control for operation at any speed.

EVERLASTING FEATURES

For more than 40 years, EVERLASTING VALVES have been known for their ingenious design, simple sturdy construction, and long trouble-free life with low maintenance expense. Some of their distinctive features are:

Quick Action . . . opened or closed with less than a quarter turn of the operating lever.

Straight-Through Flow . . . the disc cannot become loose and accidentally check the flow.

Drop-Tight Seal . . . constant contact of disc and seat at all times prevents dirt or scale from getting between.

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No Wedge Action . . . all parts move between parallel faces.

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FOR EVERLASTING PROTECTION

More FREE BULLETINS

Begins on page 165

17 ELECTRICAL EQUIPMENT — for woolen and worsted mills from picking rooms to finishing department; types, application, design of equipment; motor, controls, drives, etc. 40 pages, Booklet B-4798. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

18 MERCURY-VAPOR LAMPS—both fluorescent-mercury and straight mercury types; application, performance data, maintenance, lamp and ambient temperature. 25 pages, Booklet A-5112. Westinghouse Lamp Div, MacArthur Ave, Bloomfield, N. J.

19 BUS DUCT—application includes plug-in, low-impedance, weatherproof feeder and weatherproof low-impedance duct, accessories. 12 pages, Booklet B-5835. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

20 SELECTION GUIDE—of general purpose starters for squirrel-cage motors to 600 hp at 600 v or less. 4 pages, Bulletin 14B7733. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

21 SURGE SUPPRESSORS — and power rectifiers, selenium; dimensions and ratings. 4 pages each, Bulletins 1076 A and 1291. Accurate Engineering Co, 2005 Blue Island Ave, Chicago 8, Ill.

22 DC GENERATORS—3 to 300 kw, standard or special voltages, single or two bearing units. 4 pages, Section 600. Columbia Electric Mfg Co, 4519 Hamilton Ave, Cleveland 14, Ohio.

23 FEEDER VOLTAGE REGULATOR —user's manual includes installation, operation, maintenance of power regulators. 28 pages, Bulletin 01X7002B. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

24 PROTECTIVE DEVICE TESTER —importance of current actuated protective devices and instructions for testing and calibration in field. 12 pages. Multi-Amp Corp, Harrison, N. J.

25 PLUG-IN DISTRIBUTION PANELBOARDS—30, 60, 100 and 200 amp, 250 v with 2 and 3 pole branches; 30, 60 and 100 amp, 575 v with 2 and 3 pole branches. 8 pages. Federal Electric Products Co, 50 Paris St, Newark 5, N. J.

26 INSULATING VARNISHES—baking and air drying types, applications for each. 11 pages, Booklet 65-120. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

HEAT EXCHANGERS

27 CONDENSER TUBE INSERTS—to restore leaking tubes within first few inches of inlet. 4 pages, Bulletin 500. Thomas C Wilson, Inc, 21-11 44th Ave, Long Island City 1, N. Y.

28 EJECTORS—steam, water, process fluids in condensers and vacuum equipment. 4 pages. The Jet-Vac Corp, 73 Pond St, Waltham 54, Mass.

MAINTENANCE AND SAFETY EQUIPMENT AND MATERIALS

29 OIL DISPENSER — air pressure operated, 1 qt to 2 gal; and angle sight feed valves with needle valve control. Bulletins 82-11 and 71-41. Oil-Rite Corp, Manitowoc, Wis.

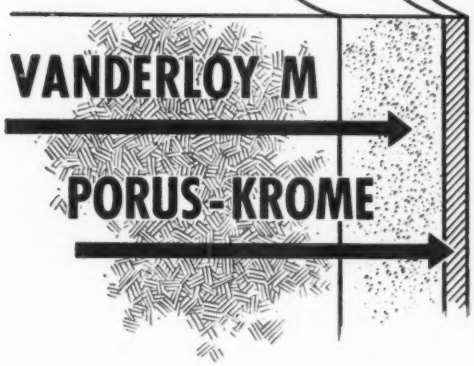
30 OCCUPATIONAL SAFETY SERVICES—tools for safety programs and training aids for instruction. 52 pages, Safety Guide 2.1. National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.

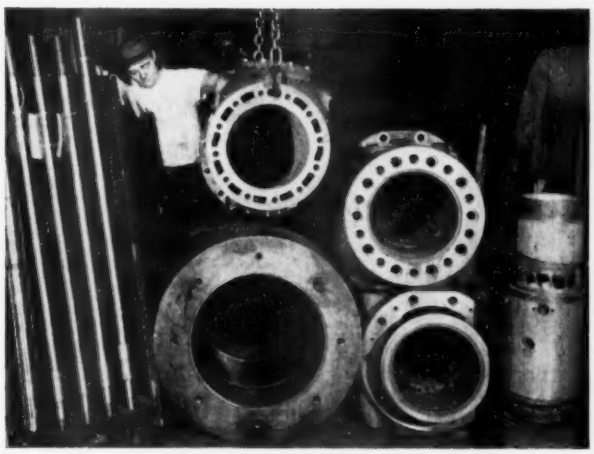
31 SEALING COMPOUND — with Molybdenum Sulfide for steam, water, compressed air applications in valves, expansion joints and pumps. 2 pages. Surveys, Inc, 219 Euclid Ave, Trenton 9, N. J.

32 ANTI-RUST PAINT—requires no surface preparations, indoors or out, available in colors. 2 pages. Paramount Industrial Products Co, University Center Sta, Cleveland 6, Ohio.

(*Continued on page 254*)

Reverse the Wear...





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* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS
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Why bother to have your liners oversized? Reverse the effects of wear — have your liners Van der Horst processed!

With VANDERLOY M we can plate back any liner you have to original size — and with PORUS-KROME* we can keep it that way.

A PORUS-KROME liner outwears as many as four unprocessed liners. Meantime, it uses less lube and fuel oil, delivers more power and is much easier on rings.

When such liners finally need replacing, simply slip in another set of Van der Horst Re-STANDARD-Sized liners — and send the worn ones back to us for renewal again.

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W52-3D

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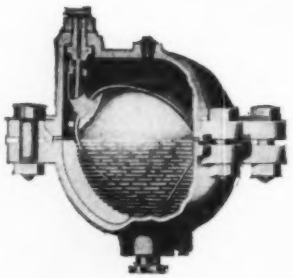
GET RID OF AIR ACCUMULATIONS IN PIPE LINES...



a BIG Trouble Saver that Costs You LITTLE!

When air lodges at high spots in pipe lines, it reduces the effective area of the pipe, creates a friction head, lowers pumping capacity, and may result in serious water hammer!

Simplex Air Release Valves bring you a sure, efficient cure for these difficulties . . . venting air *automatically before it can cause damage.*

The Simplex Air Valve is easily installed . . . positive in action . . . ample in capacity. Standard valves for pressures up to 250 p.s.i. . . . special valves for pressures up to 800 p.s.i. Thousands have been in successful use for over 30 years.

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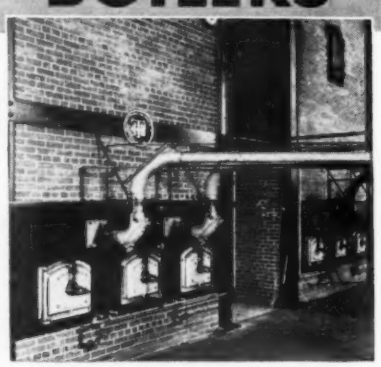
"Standard of the Industry" FOR EFFICIENT STEAM GENERATION

Schools and institutions demanding low cost boiler operation with maximum steam output are an important part of the long list of Titusville 3-Drum Water Tube Boiler users in many different fields. May we consult on your coming needs?



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Two Titusville TDL Boilers, 160 lb., pneumatic spreader stokers. Contractor: Dravo Corporation, Pittsburgh, Pa.

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34 HIGH-TEMPERATURE GREASE—with thickener of inorganic synthetic mineral particles. 12 pages. Panther Oil & Grease Mfg Co, Fort Worth, Texas.

35 HEAVY-DUTY LUBRICANT—is grease plus molybdenum disulfide for many applications. 12 pages. Panther Oil & Grease Mfg Co, Fort Worth, Texas.

MATERIALS HANDLING

36 HYDRAULIC ELEVATORS—passenger, freight and sidewalk types; engineering data and complete specs. 50 pages, Manual AIA 33. Globe Hoist Co, E Mermaid Lane at Queen St, Philadelphia 18, Pa.

37 MAINTENANCE GUIDE—for engines, marine engines, electric sets done in comic-book form. 24 pages. Caterpillar Tractor Co, Peoria, Ill.

38 BELT CONVEYOR CARRIERS—for belts 18 to 60 in. wide with 5 and 6 in. rollers. 4 pages, Bulletin 453. Stephens-Adamson Mfg Co, Aurora, Ill.

39 CONVEYOR SCALE—for weighing, integrating, regulating the flow of materials, belt passes through scale unit. 8 pages, Bulletin 301. Sintering Machinery Corp, Sinter Ave, Netcong, N. J.

MECHANICAL TRANSMISSION

40 RIVETED ROLLER CHAINS—multiple widths; assembly diagrams and charts for all size chains. 24 pages, Bulletin 52-2. Baldwin-Duckworth Div, Chain Belt Co, Springfield 2, Mass.

41 VARIABLE-SPEED DRIVES—speed ratios to 8:1 with infinite variation, ½, ¾ and 1 hp capacities. 4 pages, Bulletin V-532. Reeves Pulley Co, Columbus, Ind.

42 WORM GEARS—have high tooth-to-tooth contact, 2 to 18 in. center distance, ratings to 800 hp, speed ratios from 5:1 to 70:1. 8 pages, Bulletin MH-53. Cone Drive Gears Div, Michigan Tool Co, 7171 E McHichols Road, Detroit 12, Mich.

METERS AND INSTRUMENTS

43 INDUCTANCE BRIDGE RECEIVER—for indication, chart record, control, integration, remote control of set point and retransmission to remote indicator. 4 pages, Special Bulletin 1540. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Sta 64, Philadelphia 44, Pa.

44 RECORDING POTENTIOMETERS—circular and strip chart recorders, single and multiple record, print wheel and pen types. 4 pages each, Spec Sheets 160, 164 and 165. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Sta 64, Philadelphia 44, Pa.

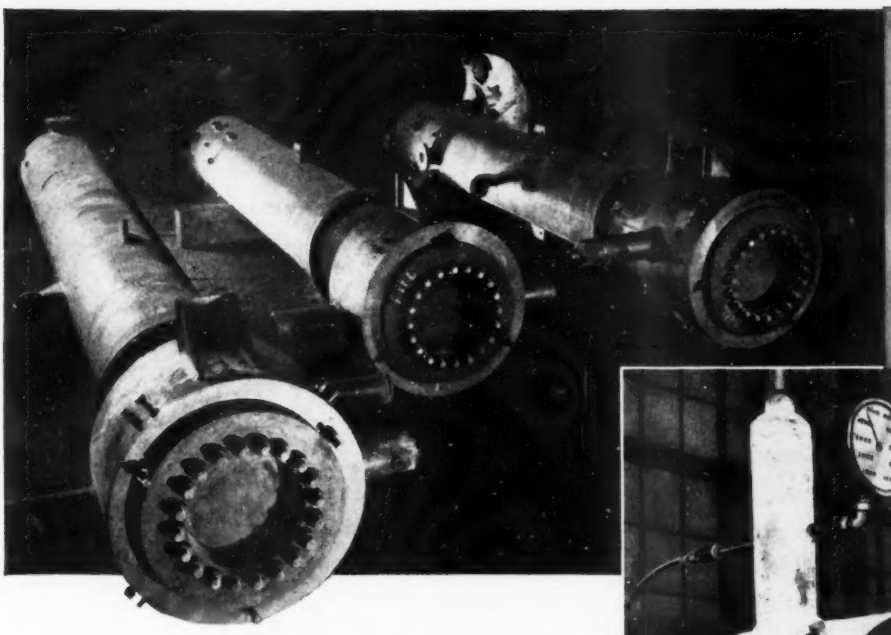
45 MEASUREMENT INSTRUMENTS—their use in solving distribution system problems, showing value of lagged meters. 20 pages, Bulletin 401-5M. Sangamo Electric Co, Springfield, Ill.

PIPING, VALVES, FITTINGS AND SPECIALTIES

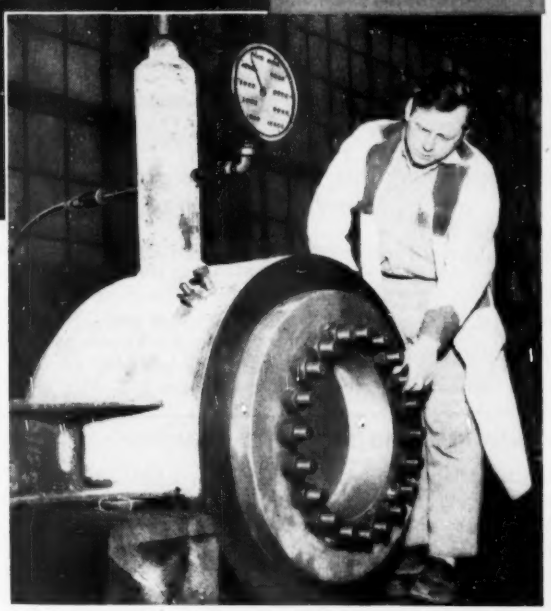
46 ROTATING STEAM JOINT—with integral drainage control, can be serviced in the line, 1½ to 3 in. Velan Engineering Ltd, 1 Exchange Place, Jersey City, N. J.

47 BALL-TYPE VALVES—from ½ to 2 in. for 300 psi working pressure; also cold forged steel unions. 4 pages each, Bulletins V4 and 25M. Rockwood Sprinkler Co, 38 Harlow St, Worcester 5, Mass.

(*Continued on page 256*)



Industry comes to A. O. Smith with Heat Exchanger Problems



A.O.Smith HIGH-PRESSURE Feed Water Heaters

Here, at A. O. Smith, is a matchless combination of designing, engineering and fabricating skills, experience and equipment on which to draw in solving any feed water heater and heat-exchanger problem. Dedicated to the search and development of better techniques, A. O. Smith engineers have created many "firsts" in the pressure-vessel and heat exchanger fields.

For high-pressure service, the exclusive A. O. Smith MULTI-LAYER process was conceived and designed for constructing thick-walled vessels and exchangers. For reliable corrosive service at minimum cost, another exclusive was developed: the SMITHlining process of permanently bonding stainless or other materials to carbon plate.

These, plus a variety of other techniques in utilizing materials of all types, are implemented by complete fabricating facilities for producing equipment, fixtures and fittings. As a result, A. O. Smith engineers are able to develop the best solution of any heat-exchanger problem.

Proof of performance is obtained with A. O. Smith's own testing procedures. Full-scale vessels are tested to destruction at isolated test stations where pressures up to 50,000 psi can be applied. Materials are tested prior to fabrication in the company's chemical, physical, metallurgical and spectrographic laboratories.

Problems are resolved by research groups whose combined experience and accumulated data are without parallel. Closely associated are the experts in tool and fixture design who have their own unexcelled facilities.

• Three high-pressure feed water heaters are shown in the upper illustration. They are designed for 2400 psi on the tube side.

• Testing the end closure and channel of one of the above feed water heaters at 4800 psi. The closure is self-sealing, of modified Bridgeman type.

• • •

For high-pressure or conventional feed water heaters and heat exchangers, whether for chemical, petro-chemical, petroleum refining or power applications, A. O. Smith is your best source. Consult the nearest district office listed below, or write: A. O. Smith Corporation, Process Equipment Division, Dept. P-653, Milwaukee 1, Wisconsin.

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Chicago 4 • Cleveland 15 • Dallas 2 • Denver 2 • Houston 2
Los Angeles 22 • Midland 5, Texas • New Orleans 12 • New York 17
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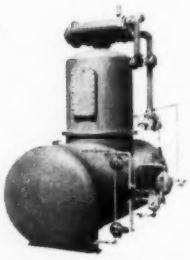
Stickle equipment is guaranteed to

Cut Steam Costs

OPEN COIL FEED WATER HEATERS

Guaranteed to heat water to a higher temperature in less space than any other heater; to deliver feed water to pump at same temperature as saturated steam in the heater. Deaerating and non-deaerating types. Deaerating type reduces oxygen content to .005 cc per liter of water. Steel or cast iron shells. Capacities: 3,000 to 300,000 pounds per hour. Bulletin 117.

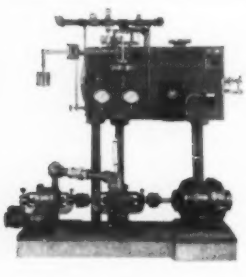


OPEN FLOAT STEAM TRAPS

Provide quick sure drainage of heating and processing units. Instantaneous discharge of air and non-condensable gases. Operate on time-tested open float principle. Self-regrinding valve and seat. No levers, hinges or pins to replace; no thermal elements or diaphragms to rupture or crack. Many still in use after 40 years. Sizes and styles for every need. Bulletins 115, 315, and 415.

REGULATING AND REDUCING VALVES

Provide automatic pressure regulation and reduction for liquid, air, steam. Used where most exacting control is essential. Self-contained. Single seated, balanced . . . or double seated, semi-balanced. Spring or lever weight-loaded. Lever or float operated. All parts accessible without removing valve body from the line. Available in wide range of sizes and styles. Bulletins 235 and 435.



DIFFERENTIAL DRAINAGE AND BOILER RETURN SYSTEM

A closed pumping system for returning condensate from heating and processing units to boilers at a temperature only 15 to 20 degrees lower than temperature of steam at operating pressure. Saves 10% to 25% of boiler fuel. Increases boiler capacity. Maintains higher, more uniform pressure. Delivers drier steam at higher temperature. Reduces raw make-up water and scale 85%. Bulletin 250.

STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS 18, INDIANA

Stickle has engineered and built *guaranteed* steam specialties since 1905

More FREE BULLETINS

Begins on page 165

48 **VALVES** — needle, globe, plug, check, relief and special types plus gage protectors and snubbers, bleeders and vacuum control valves. This bulletin contains 44 pages, Catalog 352A. Republic Mfg Co, 1930 W 77th St, Cleveland 2, Ohio.

49 **ROTARY PRESSURE JOINT**—for steam and liquids, low pressure to 350 psi, high pressure to 3500 psi, ¼ to 5 in. pipe sizes; also pressure relief valve and check valve. Anco Inc, 1 Baker St, Providence 5, R. I.

50 **FLEXIBLE METAL HOSE**—application and temperature ranges of various types of metal and wire braided hose. Technical Data Book U-111. Universal Metal Hose Co, 2133 S Kedzie Ave, Chicago 23, Ill.

51 **NON-METALLIC DISC VALVES**—in bronze, iron and steel; discs for saturated steam, cold water, air and gas, and gasoline, oil, butane and propane. 4 pages, Circular 558. The Lunkenheimer Co, Box 360-U, Cincinnati 14, Ohio.

PRIME MOVERS AND ACCESSORIES

52 **ENGINES** — oil diesel, dual fuel diesels and high compression spark ignition engines and their new developments. Described in bulletin S-500-B55. Engine Div, Worthington Corp, Buffalo 5, N. Y.

53 **4-CYCLE ENGINES** — gas, diesel and gas-diesel, atmospheric, supercharged, vertical 4-cycle, 6, 7, and 8 cylinders, 15½ in. bore, 22 in. stroke. 12 pages, Bulletin L-71. The Cooper-Bessemer Corp, Mount Vernon, Ohio.

54 **DIESEL ELECTRIC SETS**—30 to 100 kw, describes fuel, lubrication and cooling systems, complete specs. 20 pages, Form 30507. Caterpillar Tractor Co, Peoria 8, Ill.

PUMPS

55 **HEAVY-DUTY**—variable delivery pumps, variable speed transmissions, variable and constant displacement motors; drawings, complete specs. Waterbury Tool Div, Vickers Inc, Waterbury, Conn.

WATER TREATMENT

56 **ZEOLITE WATER SOFTENER**—sodium and hydrogen cycle, principles and details, operation and design of equipment. 12 pages, Bulletin WC-108. Graver Water Conditioning Co, Dept 103-8, 216 W 14th St, New York 11, N. Y.

WELDING

58 **ALLOYS AND ELECTRODES**—for resistance welding; data on holders, tips, seam welder wheels, shafts, bushings, and flash, butt, barrel and projection welding dies. 24 pages, Bulletin RW-1a. Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.

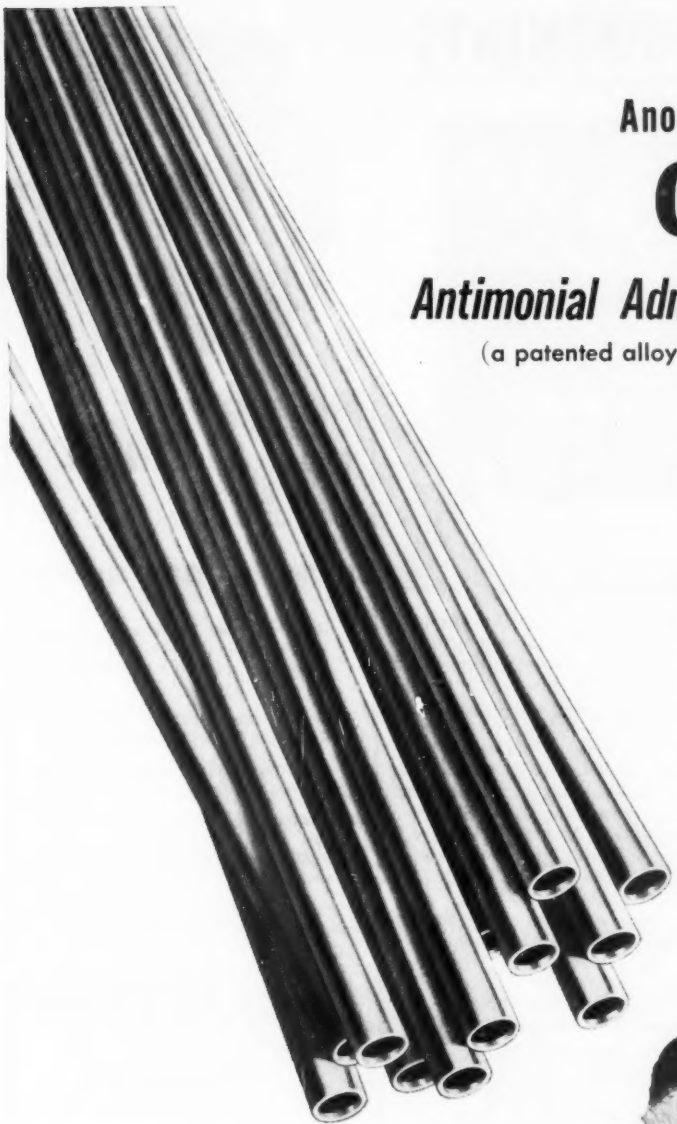
59 **STAINLESS STEEL ELECTRODES**—lime coating for dc reverse polarity and ac-dc types, complete data. 20 pages, Bulletin AR53-16. Alloy Rods Co, York, Pa.

MISCELLANEOUS

60 **PRINTING CALCULATOR** — an adding-machine-type machine that finds percentages with minimum work. Booklet AC 639. Remington Rand Inc, 315 Fourth Ave, New York 10, N. Y.

61 **REPRODUCTION MACHINE**—office machine exposes, develops, prints any record or log to 14½ in. wide in less than a minute without washing, fixing or drying. Booklet P344. Remington Rand Inc, 315 Fourth Ave, New York 10, N. Y.

62 **BUILDING FOR POWER**—records concept of responsibilities and qualifications of prime contractors who build for power, describes major public utility projects. Arthur A Johnson Corp, Engrs & Contrctrs, 347 Madison Ave, New York 17, N. Y.



Another reason why

Chase

Antimonial Admiralty Tubes last longer!*

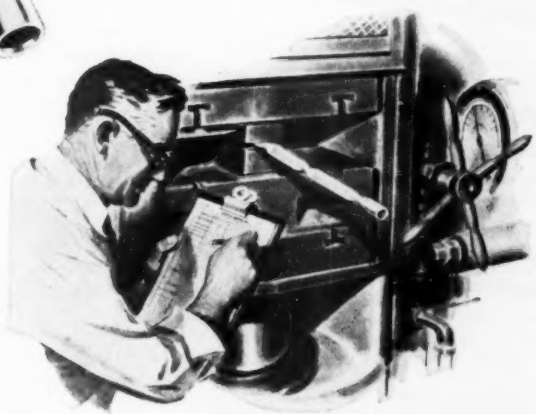
(a patented alloy)

Yes, you can *count* on Chase Antimonial Admiralty Condenser Tubes to give you many years of satisfactory service.

Chase Condenser Tubes are rigidly controlled for quality during manufacture, and various tests are applied when the tube is finished. The flattening test mentioned below is a good example. Wall thickness, diameter, surface finish, concentricity and accuracy of length are carefully determined.

So, for condenser tubes that last and last, *remember:* insist on Chase Antimonial Admiralty!

*U.S. Pat. No. 2,061,921



PUTTING THE SQUEEZE ON IMPERFECTIONS...

This Chase technician is performing a "flattening test" which is an indication of soundness and freedom from hidden defects. You are assured that tubes passing this test will satisfactorily withstand bending or end flaring.

PROMPT SHIPMENTS from our mills in Cleveland and Waterbury.

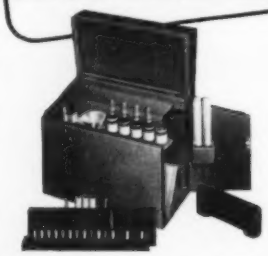
Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany †	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver †	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston	Newark	Rochester †	(† sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)

power men say they're
TOPS FOR SPOT BOILER WATER pH, PHOSPHATE TESTS



Taylor Boiler Water Comparator. Slides for pH available as low as 0.2 or as high as 13.6. Phosphate slides work on the same base.

TAYLOR COMPARATORS
with
GUARANTEED COLOR STANDARDS

EASY TO USE--

Taylor Comparators use the familiar colorimetric method of comparison . . . but without the need for handling fragile single standards! Each complete set of Taylor Liquid Color Standards in sturdy plastic slide, many slides usable on same base.

FAST TO USE--

many determinations can be made in a matter of seconds, others take no longer than two minutes.

CONVENIENT TO USE--

you can carry the lightweight set to testing spot, no need to carry solution samples back to the lab.

ACCURATE TO USE--

because all Taylor Liquid Color Standards are unconditionally guaranteed against fading, thus there is no chance of mechanical inaccuracy.

WANT TO KNOW MORE?

See your lab supply dealer to inspect Taylor sets or write direct for a free copy of this interesting and informative handbook, "Modern pH and Chlorine Control". It describes theory of pH and chlorine control and applications to 34 basic industries. Also illustrates and describes the full line of Taylor Sets.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

APPOINTMENTS

Joseph V Santry

Corporation Executives

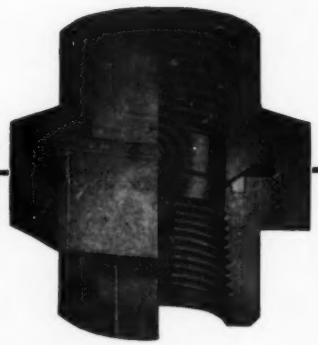
Stockholders of Combustion Engineering—Superheater, Inc. have voted to shorten the company name to **Combustion Engineering, Inc.** At the same time the board of directors elected the following officers to new posts: Joseph V Santry, president, was elected chairman of the board and will continue as chief executive officer; Samuel G Allen retired as chairman of the board but will continue as chairman of the executive committee; Martens H Isenberg, executive vice-president, was elected president, succeeding Mr Santry; George D Ellis, vice-president and controller, was appointed vice-president in charge of finance, succeeding Harold H Berry who has reached the retirement age. Mr Berry will continue as a director.

Carl A Bock is named executive director of the **Puerto Rico Water Resources Authority,** San Juan. Bock was formerly director of engineering for the Tennessee Valley Authority. N George Belury has been elected a vice-president of **American Brake Shoe Co. Raybestos-Manhattan, Inc,** elected W S Simpson, vice-president in charge of the Raybestos Division, and appointed M A Thompson, assistant comptroller of the corporation.

The Northern Pennsylvania Power Co has elected Col John F A Beirne a vice-president of the company. **The American Blower Corp** announces that Edward W Legier has been elected a vice-president. James J Reynolds, who had been a member of the National Labor Relations Board from 1946 through 1951, has been appointed vice-president in charge of industrial relations for **American Locomotive Co.**

Stockholders of **The Babcock & Wilcox Co** voted to increase the number of directorships from eight to 11, and elected Edward L Cochrane, J H King and Luke E Sawyer to fill the newly created posts. At the same time W H Rowand, chief engineer of the Boiler Division of B & W, and M Nielsen were elected vice-presidents of the company.

(Continued on page 260)



Ask yourself these questions before you buy pipe unions again

1. Are the unions you're using designed having a truly spherical ball joint with brass seats recessed for protection and free-flow?
2. Do they have octagonal ends for easy tightening by any type wrench?
3. Are they *plainly marked* for 300# pressure?
4. Are they made of Air Furnace Malleable Iron with a tensile strength of 55,000 p.s.i. and air tested before shipment?

If you can't answer "Yes" to *all* these questions, you're not using

Jefferson
UNIONS

. . . and you're not taking advantage of all these features which are back of Jefferson's reputation for high quality, maximum service and economy at a slightly higher cost.

Jefferson offers OWG 2000# to 2" and 1000# up to 4". The line includes AAR male and female unions, Enduro 300#, Excel 250# and Master 150# unions. All iron seats are also available in all types.

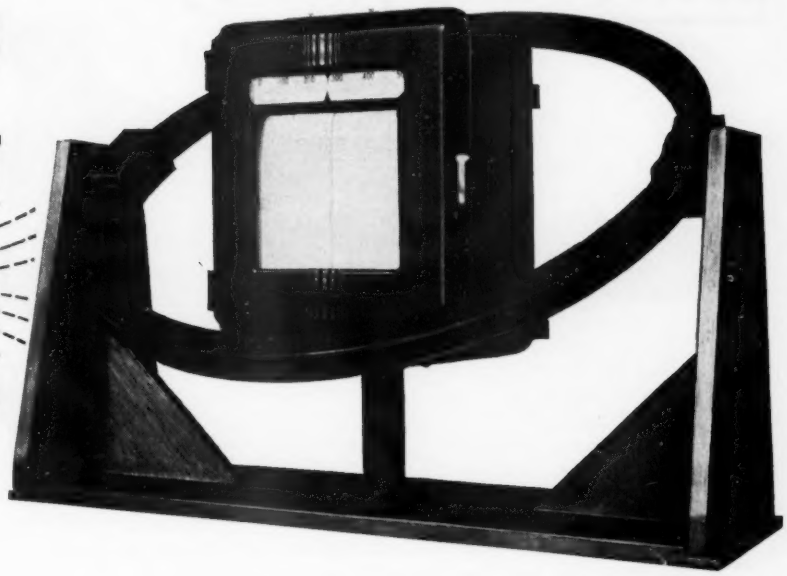
Contact your nearest distributor or us direct for your requirements.

●

JEFFERSON UNION CO.
605 W. 26th St., New York 1, N. Y.
63 Gooding St., Lockport, N. Y.
39 Fletcher Ave., Lexington 73, Mass.

Here's how L&N engineers verify Speedomax resistance to stray electrical fields. The ring is a Helmholtz coil, adjustable for a wide variety of field effects.

Speedomax is engineered for FIELD service



● Built into every Speedomax recorder and controller is a high degree of indifference to stray electrical fields. And this is one of its most useful characteristics in almost any job. It means that you can install a Speedomax near a big motor, power line or X-Ray machine—any electrical equipment in fact—and you'll probably see no effect at all from surrounding electronic noise and "junk".

The reason for this indifference to stray fields goes back through the adjustment, building and design of the instrument, to its basic engineering. Speedomax has an *electronically-clean measuring circuit*, as well as clean signal and amplifier circuits.

This clean design includes a bifilar-effect slidewire, to eliminate any objectionable inductance at that point. It includes our "no-moving parts" trolley contact on the slidewire, which eliminates pigtails and their variable inductances. It includes use of a Mumetal slidewire shield where desirable, instead of less expensive but lower-permeability aluminum. And it includes a lot of just downright meticulous detailing, such as carefully engineered wiring and input filtering, plus ingenious shielding where required.

These and other precautions eliminate out-of-phase components in the supply to the amplifier. The latter therefore doesn't "load"; hence sends the correct amount of correct-phase power to the balancing motor. With ample power, the motor's recording and control action is snappy and accurate.

Our Catalog ND46(1) and Technical Publication ND46(1) tell the story. Write our nearest office or 4910 Stenton Avenue, Philadelphia 44, Pa.

Industry's engineers find that Speedomax instrument performance is not affected by the stray fields created by motors, electric furnaces, magnets, power lines and so on.

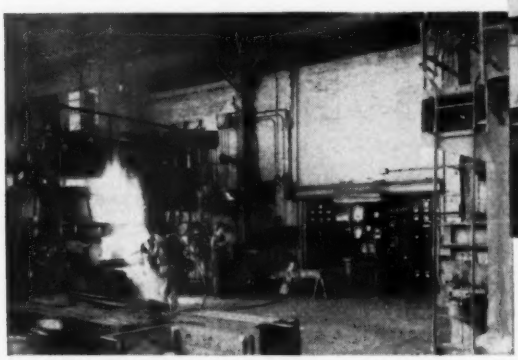


PHOTO COURTESY A CASTINGS MANUFACTURER

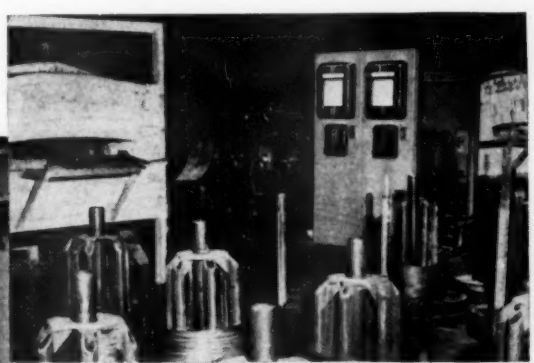


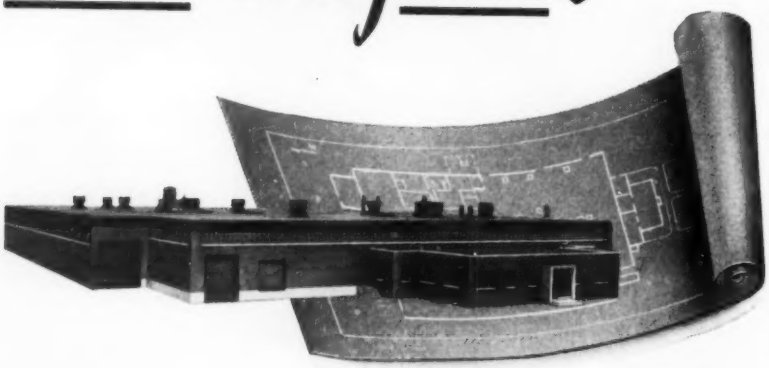
PHOTO COURTESY LACLEDE STEEL CO.

Jrl Ad ND46(10)

LEEDS NORTHRUP

instruments automatic controls • furnaces

better—and faster!



The George Sall Metals Co., Inc., Philadelphia, Pennsylvania
Designed and Constructed by The Kuljian Corporation

Thanks to single control teamwork between owner-management on one hand, and engineer-constructor on the other, the new George Sall Smelting Plant in Philadelphia produces non-ferrous metals and alloys from scrap metal at higher speed and with greater uniformity and purity than ever before.

The Kuljian Corporation, under a single contract, designed and constructed this modern plant which today is the envy of the industry.

Backed with years of experience in many diversified industries, The Kuljian Corporation offers you the following services:

1. ENGINEERING—Preliminary studies and layouts followed by complete detailed working drawings and specifications; the service of a resident engineer during construction is optional.

2. CONSTRUCTION—Management of the over-all project including coordination of all subcontractors and all directly employed field forces; accounting and purchasing services are optional.

3. ENGINEERING AND CONSTRUCTION—Both of the above services on a single contract with unified responsibility for the project from preliminary studies to completed construction.

The Kuljian Corporation

ENGINEERS • CONSTRUCTORS

1200 North Broad Street, Philadelphia 21, Pa.

MEXICO CITY • CARACAS • MADRID • ROME • ATHENS • TOKYO • CALCUTTA • BAGHDAD • FRANKFURT

More APPOINTMENTS

Begins on page 258

Operations Executives

Three new **Detroit Edison** appointments include: Eldred H Scott, to controller from his former post as assistant controller; Arthur E Bush, to assistant controller from his former position as statistician; and Russell G Vernon, assistant secretary in charge of the New York City office, also to be assistant treasurer. Samuel P Felix has been appointed general manager of the **De Laval Turbine Pacific Co.** Elmer J Keller, assistant chief inspector at the Indiana Harbor plant of **The Youngstown Sheet and Tube Co,** has been appointed superintendent of Youngstown's Harbor pipe mills. He succeeds Eric Jansson who has left the company. Emmett E Holmgren, inspection foreman at the hot strip mill succeeds Keller as assistant chief inspector.

Francis K McCune has been appointed general manager of the **General Electric Co's** Atomic Products Division. **The Cooper-Bessemer Corp** reveals that Tom McMichan, works manager, and Frank Stevenson, assistant works manager, of their Grove City plant, have been appointed special assistants to the president and will now be stationed at the headquarter plant in Mount Vernon, Ohio. Willard Luli, formerly production manager, has been named works manager at Grove City, and Hugh Stevenson, formerly superintendent, is now assistant works manager. Ken Martin has been appointed production manager, Guy Gahagan, general superintendent, and Clarence Evans, shop superintendent, day shift, at Grove City.

Albert T Both, who has been general superintendent in charge of Cleveland operations for **Chase Brass & Copper Co, Inc,** has been appointed works manager at Cleveland, and Charles W Yarrington has been appointed general superintendent of the Chase Cleveland mills. **The Permutit Co** announces the promotion of Durando Miller Jr, to assistant technical manager. Appointment of Joseph R Kerner as distribution apparatus manager for the Eastern district has been announced by the **Westinghouse Electric Corp.** Dr Leland M White has been appointed assistant director of the research and development department of **United States Rubber Co.**

F O Pauls is export manager of the **Jas P Marsh Corp. Johns-Manville's** six new regional construction managers are: W H G Murray, New York region, Syracuse, N.Y.; V D Suiter, Philadelphia region; James Collins, Cleveland region; H P Barnes, St. Louis region; W F Quinby, Houston region; and J P Jobe, Los Angeles region. G L Maw has been named assistant Cleveland region construction manager with headquarters in Detroit.

Sales Managers and Personnel

Joseph J Lengyel becomes manager of marketing for **General Electric's** Construction Materials Division. Appointment of Thomas E Bell as sales manager for the **Republic Flow Meters Co** is announced. Richard K Hulett, who has been with the **Iron Fireman** Cleveland office and field engineering staff since 1950, has

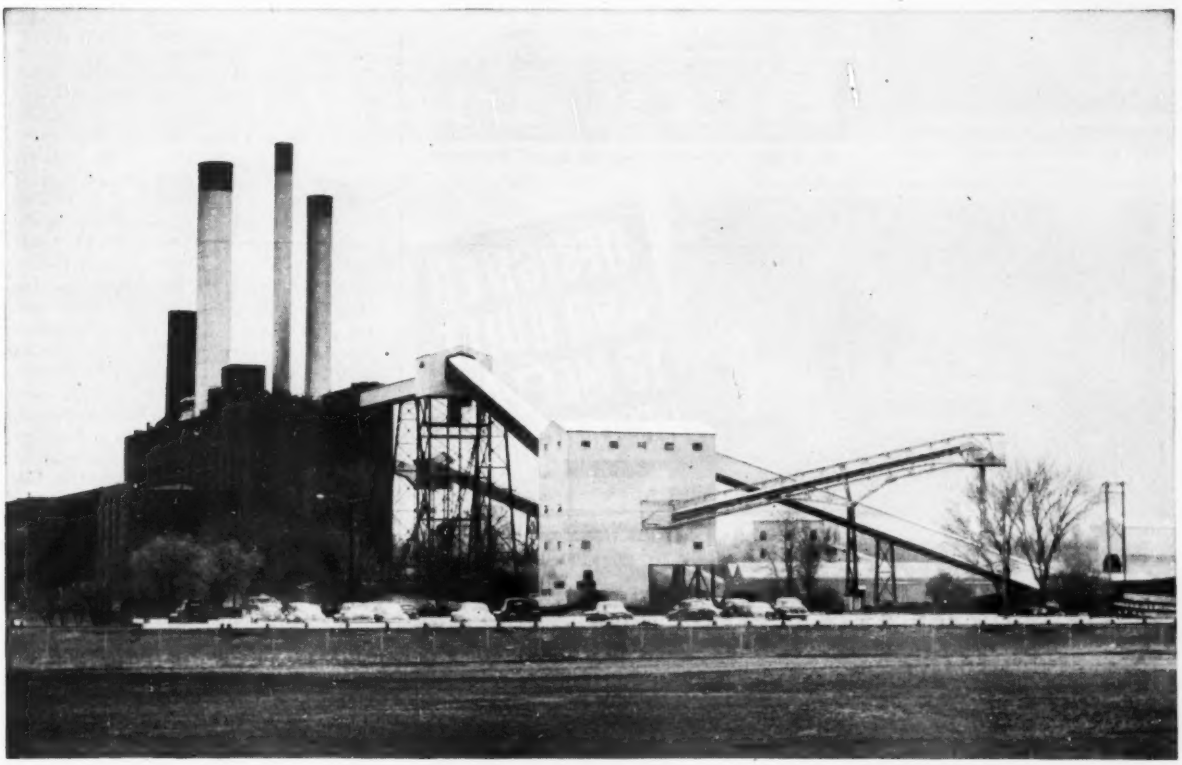
S-A CONVEYING Systems

prove **SUPERIOR** for **ECONOMICAL** Coal Handling Operations

COAL—mountains of coal—has been moved and is being moved speedily, efficiently and at lowest cost per ton by S-A equipment and installations! S-A engineers have the *know-how* to solve the most complex coal handling problems. And they draw upon a complete, time-proved line of bulk materials handling equipment which is demonstrating its superiorities all over the world. A few lines on your letterhead will bring information.

Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll & Ring Type
Bucket Elevators
Pivoted Bucket Carriers
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Track Hoppers & Bin Gates
TELLEVEL Bin Level Controls
Water Intake Screens
SEALMASTER Ball Bearing Units

Write for a bulletin on any of the above.



The above public utility plant now has a complete S-A coal handling installation, modern to the Nth degree! A complete belt conveyor system moves coal from receiving to storage and reclaims from storage for direct delivery to the plant.

STEPHEN S-A MFG. CO. ADAMSON

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

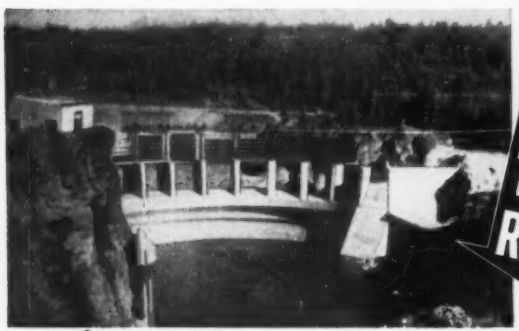
Kept cool with a FRICK Unit Air Conditioner

This Carvel soft ice cream station is one of two on Long Island, N. Y., cooled with Frick units. Installation by Hallam Engineering and Construction Corp., Frick Distributors at Brooklyn for 35 years.

Frick unit conditioners are a quality product, built for a discriminating trade. They are heavier, run more quietly, and have a much longer life. Larger surfaces and better engineering provide more cooling per dollar. Made in 3, 5 and 7½ h.p. sizes: get the whole story: write

Built into Frick Air Conditioners are 100 Years of Engineering Experience

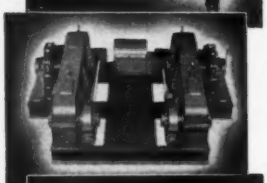
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U.S.A.
Also Builders of Power Farming and Sawmill Machinery

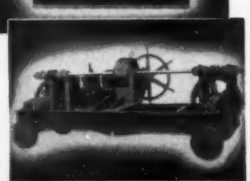


DESIGNED AND BUILT TO MEET ALL REQUIREMENTS

Murray GATES & GATE HOISTS! for any Size Power Dam

Cabinet Gorge Dam On Clark Fork River Idaho





MURRAY GATE HOISTS are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist.

In over 50 years of designing and building gate hoists, we have developed designs for many gate hoist problems. We may have designs and patterns to fit your special requirements. In planning gates or gate hoists, we suggest you write us before your over-all plans are complete . . . it may save time and money. We also build gate hoists to fit your plans and specifications.

Write for complete information and Engineering Department recommendations.

MURCO

D. J. MURRAY MANUFACTURING CO. WAUSAU, WIS.

More APPOINTMENTS

Begins on page 258

been advanced to assistant industrial sales manager. John G Hoyt Jr, a district sales supervisor of **Rockwell Manufacturing Co's** Water Meter Division, has been named assistant sales manager of the division.

Edward T Day has been named manager of branch sales for mechanical goods division, **United States Rubber Co.** Appointed at the same time was Matthew J Delehaunty, who becomes manager of industrial sales. Both men will be headquartered in the company's New York offices. The appointment of Charles F Venrick as manager, Alco-GE locomotive sales and field service and Ralston A Weston as manager of stationary and marine diesel engine sales was announced by the **American Locomotive Co.** Paul Feeger has been assigned to the Albuquerque industrial sales engineering staff of **Minneapolis-Honeywell Regulator Co.** Thomas E Bell, district manager of the **Republic Flow Meters Co** in Atlanta, has been promoted to general sales manager of the company with headquarters in Chicago. He is succeeded in Atlanta by Thomas W Waldrop.

William J Healy, sales manager of the **De Laval** turbine division, has been appointed to the additional post of sales manager for the blower and compressor division. **General Electric's** Trumbull Electric Department announces that J E Kerby has been named manager of the newly created West Central district, with headquarters in Kansas City; A P McGraw becomes manager of the Southwest district, with offices in Houston; and J E Van Effen is named manager of the newly established Cleveland district, with headquarters in Columbus. Dr Elden D Haller, senior sales engineer with **Beckman Instruments, Inc,** has been appointed eastern sales manager for the South Pasadena concern. Appointment of J V McGuire as sales manager and of George W O'Keeffe and Clinton F Kucera as assistant sales managers of **Allis-Chalmers'** new Switchgear Department was announced. J E Carroll was appointed district sales manager at Cincinnati for the **Graybar Electric Co.**

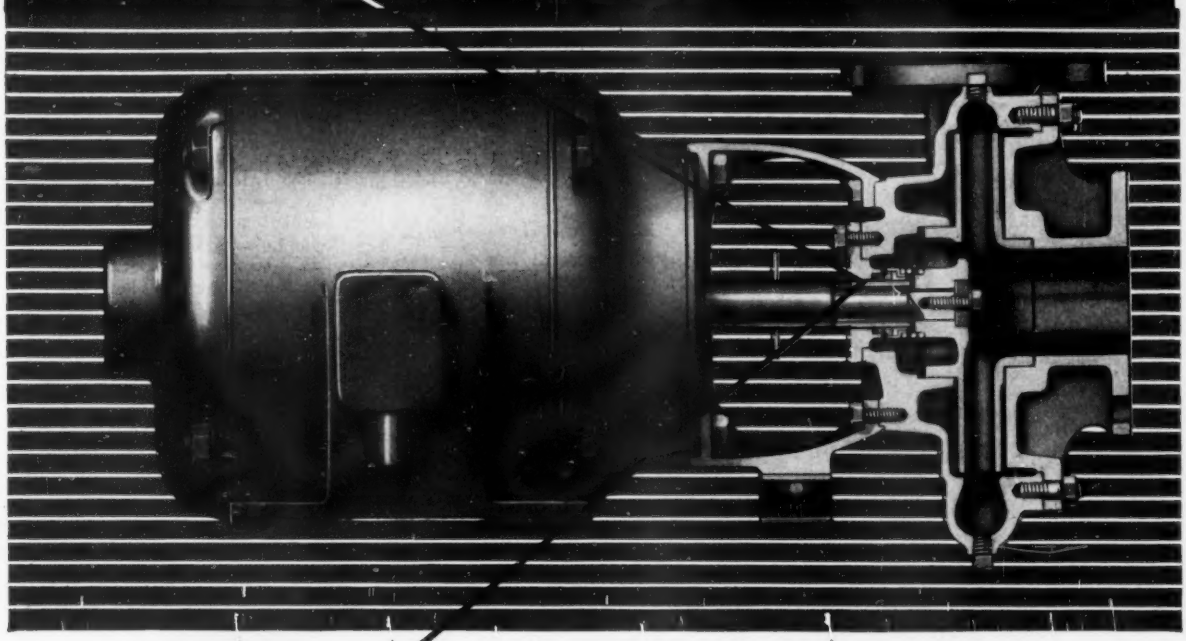
Branch, Sales, Service Offices

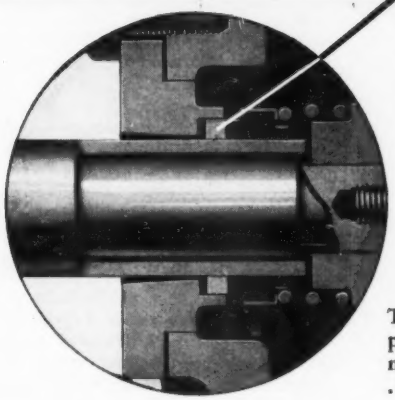
Establishment of a San Francisco branch office of the **Westinghouse Electric Corp** has been announced to provide better service to customers in northern California and western Nevada. The combination of **Allis-Chalmers'** district and branch office territories of Denver, Salt Lake City, Phoenix, El Paso, and Spokane into the Rocky Mountain region with headquarters at Denver has been announced. Richard D Moody, since 1950 manager of the Los Angeles district office, has been appointed manager of the new region. Successor to Moody as manager of the Los Angeles district office is Richard L Engel.

The Permutit Co announces the removal of its Los Angeles sales office to 302-B S Brand Blvd, Glendale 4, Calif. **Orr & Sembower, Inc,** moves its midwestern district office from Cleveland to 4809 Claremont Ave, Chicago.

(*Continued on page* 264)

NEW *Remite* SEAL ENDS LEAKAGE TROUBLES





Cross-section showing Remite Mechanical Seal.

B&G *UNI-BUILT*

SERIES 1531 CENTRIFUGAL PUMP

The "REMITE" Mechanical Seal of this pump presents a revolutionary new development in pump design . . . eliminates leakage . . . assures long, trouble-free life.

A carbon seal ring faces on a "REMITE" floating seat—a new type of material, *so hard it will scratch glass*—wear-proof and corrosion-resistant! This Seal is self-lubricating.

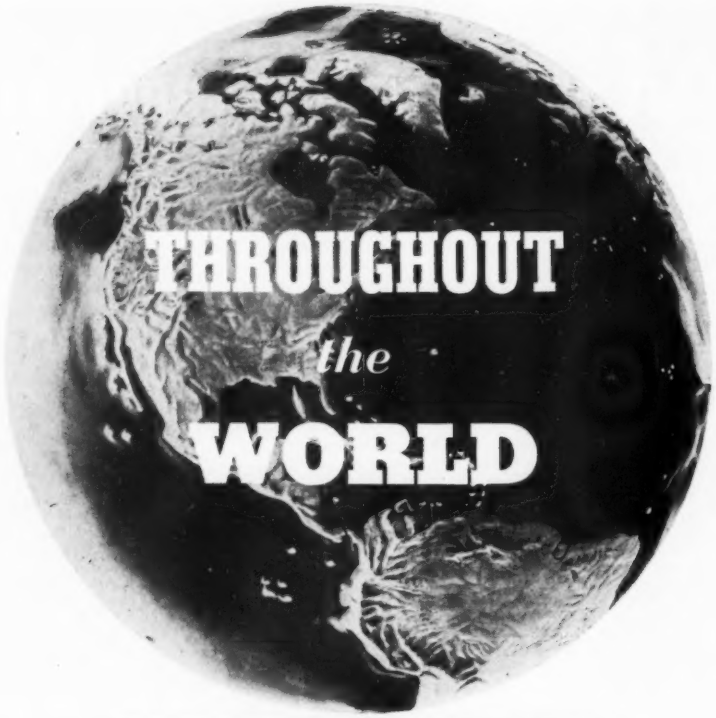
Note the pump shaft . . . super-finished high grade steel . . . oversized for minimum deflection . . . quiet. The impeller is of sound hydraulic design, mechanically balanced, with balance ring and relief holes to reduce thrust. The heavy duty ball-bearing motor is normally furnished as drip-proof, but is also available in splash-proof, totally enclosed and explosion-proof models.

B & G Series 1531 Uni-built Pumps are made with capacities to 1200 GPM, heads to 400 feet.

Send today for catalog No. ET-452, giving complete engineering data on the B & G Series 1531 Uni-built Centrifugal Pump.

BELL & GOSSETT
COMPANY
Dept. CZ-36, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto, Canada



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228

More APPOINTMENTS

Begins on page 258

Distributors, Representatives

The Hank Thurstin Co of Denver, Colorado, has been appointed by **The Terry Steam Turbine Co** to handle the sale of its turbines in Colorado, Wyoming, western Nebraska and northern New Mexico. **Warren Steam Pump Co, Inc,** announce the appointment of Wilcox Engineering Co, 126 Wellington Place, Cincinnati 19, Ohio, and William J Inwood, 1511 Security National Tower, Battle Creek, Michigan, as sales representatives. Appointment of Herman E Trotter as Buffalo, N. Y, representative of **B-I-F Industries** has been announced by that firm.

Copes-Vulcan Division, Continental Foundry & Machine Co, announces the appointment of Power Economy, Inc, 4526 Olive St, St. Louis 8, Missouri as representatives. **American Flexible Coupling Co,** has announced the appointment of The Paddon Co, P O Box 394, Youngstown, Ohio, and Central States Engineering and Sales Co, 5101 Blondo St, Omaha 4, Nebraska, their new sales engineering representatives.

Societies, Schools, Associations, etc

Appointment of CA Badeau, chief engineer of The Thomas & Betts Co, to its codes & standards committee was announced by the **National Electrical Manufacturers Association.** L C McKesson, vice-president in charge of sales, Ansul Chemical Co, Marinette, Wisconsin, was elected president of the **Refrigeration Equipment Manufacturers Association.** R C Wietersen, director of purchases of the Buda Co of Harvey, Illinois, has been elected president of the **Internal Combustion Engine Institute.**

At the American Power Conference in Chicago the **National Association of Power Engineers** elected as president Gerald Mierendorf, superintendent of power plants for the A O Smith Corp, Milwaukee. A proposed merger of the **Refrigeration Equipment Manufacturers Association** and the **Air Conditioning and Refrigeration Machinery Association** was approved by the boards of directors of both associations. George S Jones Jr, former vice-president in charge of sales for Servel, Inc, will head the organization as managing director. Robert J Stormont, vice-president and general manager of The Wickes Boiler Co, has been named chairman of a newly organized Saginaw Valley Sub-Section of the **American Society of Mechanical Engineers**

Obituaries

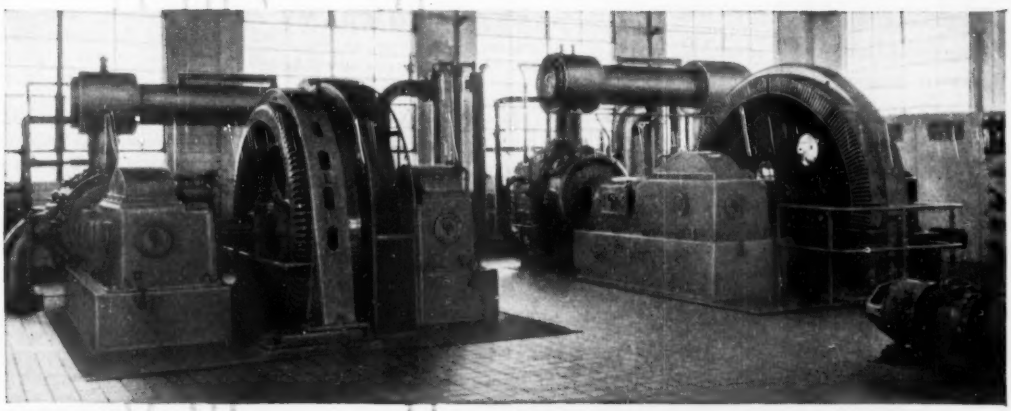
Arnold Pfau, 79, world-renowned hydraulic engineer and retired consulting engineer to hydraulic department of Allis-Chalmers Mfg Co, February 8, in Roanoke, Ill.

James Wilson, former president, The Shawinigan Water and Power Co, Montreal, March 22.

J Gordon Turnbull, consulting engineer for design and construction of Ford's River Rouge plant, the Knolls Atomic Laboratory, and many others, April 1, in Los Angeles.

NO CLOCK PUNCHING

for these compressors



That's right! There's no daily time limit placed on the work output of Chicago Pneumatic Class O-CE Compressors . . . they operate "around the clock" with a minimum of attention. Designed for continuous, year-in, year-out heavy industrial usage, these units are unsurpassed for a dependable air power supply at low cost. Built in sizes up to 2,000 hp, for pressures up to 5,000 lbs., they are available in horizontal, two-stage, water-cooled types with direct-mounted synchronous motor drive.

The Chicago Pneumatic Class O-CE Compressor is equipped with roller bearings, Simplate valves for low power consumption, streamlined air passages to cut down air flow resistance, CP Multi-Step Control for partial load economy, and a CP Intercooler for maximum heat transfer and low water consumption. Ask for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, N. Y. 17, N. Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Cut Piping Costs

WITH ... Babbitt Adjustable SPROCKET RIM with Chain Guide

Save money! Lay out your overhead piping plan for utmost efficiency, convenience and economy — without special stairs, catwalks, balconies, or detours to floor level to bring valves within reach. Low-cost Babbitt Adjustable Sprocket Rim with Chain Guide makes every overhead valve easily accessible. Saves fuel and steam costs, too.

- Simplifies pipe layouts
- Prevents accidents
- Fits all valve wheels

Four simple, quickly-assembled parts quickly installed—in range of 10 adjustable sizes to fit all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS.

for cleaner Over-all combustion

LUBAID D

LUBAID-D is a diesel fuel additive that aids in achieving better, lower-cost performance, with shorter outages. LUBAID-D aids in dispersing gum, sludge and varnish. Aids in achieving free pumping. Aids in maintaining maximum compression pressures. Aids in achieving cleaner combustion, and reduction of port clogging and sticking valves.

LUBAID COMPANY

Address Inquiries to Milwaukee Office

MILWAUKEE, WISCONSIN and NEW YORK CITY

PROTECT Valuable Equipment with ADSCO STRAINERS

● Uniform, snug fit of screen in ADSCO Y-type Strainers is guaranteed by gasketed cap and tapered seats. When furnished with semi-steel body and perforated brass-sheet screen, these strainers are of 250 lb. design. Screen ratios as high as 8-to-1. Bodies and screens of other metals furnished for higher pressures and temperatures. Write for Bulletin 46-50B.

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

More POWER NEWS

Begins on page 150

A new 16mm sound motion picture in color, *The Science of Making Brass*, is now available for showings to brass users throughout the United States from **Chase Brass & Copper Co, Inc.** Extensive use of animation explains the details of casting, extrusion, drawing and rolling processes. Modern production and quality control techniques are shown in sequences taken in the Chase research laboratories. The film is being offered on a loan basis to metal-working industries, technical schools and state and local technical groups. Requests should be addressed to Chase Brass & Copper Co, Inc, Waterbury 20, Conn., or to any Chase warehouse or sales office in the United States.

A search for additional sources of the costly metal germanium for use in electronic equipment has been launched by the Bureau of Mines in ash pits and smoke stacks of large industrial consumers of coal. The Bureau's search is being concentrated on central station power plants which burn a total of more than 100 million tons of coal yearly.

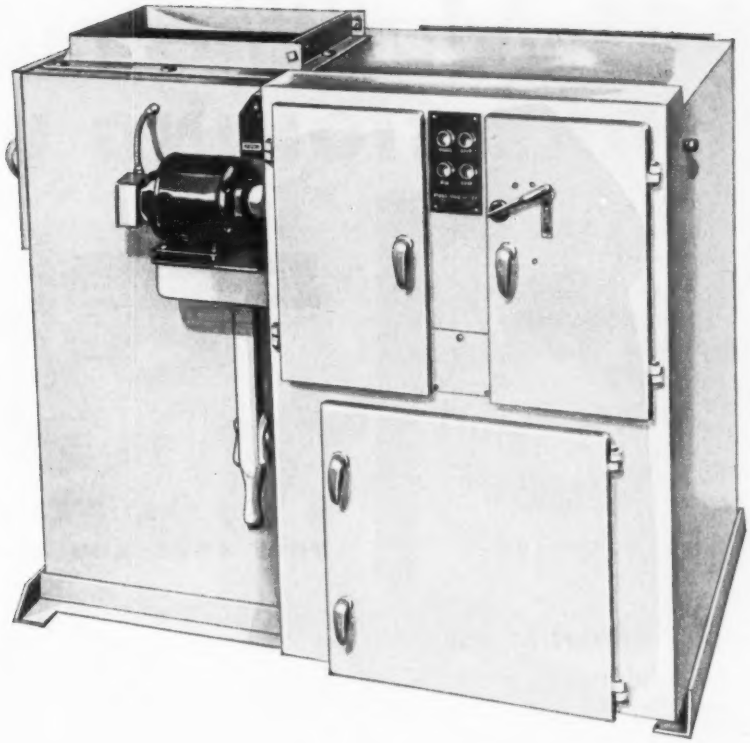
Selling at approximately $350 a pound, or nearly 65 per cent the price of gold, all germanium metal used in the United States today is recovered from sludges during the production of electrolytic zinc. Annual output is about 6,000 pounds, but some predict the electronics industry will require 40,000 pounds yearly by 1956.

Engineers in industry will have an opportunity to study the applications of new techniques and methods in Lubrication Engineering during a two-week Special Summer Program from June 16 to 26 at the Massachusetts Institute of Technology. The program is intended primarily for engineers responsible for lubrication maintenance and scheduling in industrial plants, and for others in the oil industry who wish to become better acquainted with the field.

Further information and application blanks may be obtained from the Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

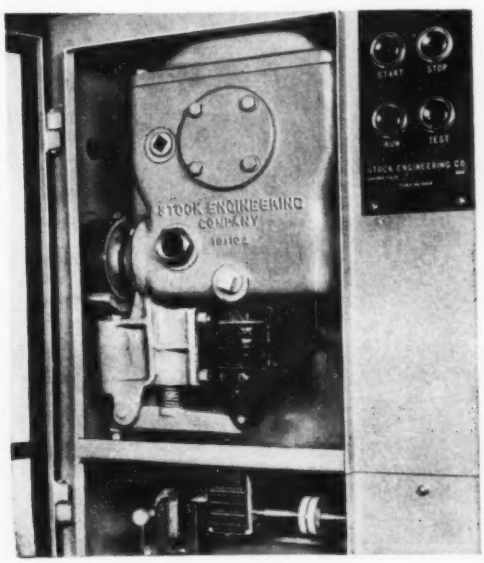
Melbourne—(McGraw-Hill World News) —New Zealand is likely to become the first country in the world to apply geothermal steam to the production of heavy water and also the first country to harness geothermal steam for the dual purposes of making heavy water and electricity.

Geothermal steam tapped from far below the earth's surface will be used to produce heavy water for use as a moderator in atomic piles and would be exported from New Zealand to the United Kingdom, United States and, later on, to Australia. Further research on the best methods of production is in progress. Actual production of atomic power in New Zealand is not contemplated, but New Zealand scientists would like to cooperate with Australia in establishing there an atomic pile. According to some plans, this pile would be in operation before 1960.



The Boiler With S-E-Co. Coal Scales

Close-up showing reducer, brake, and easily accessible tare and compensator adjustment mechanisms.



can squeeze the last BTU from each pound of coal because its operator knows exactly how many pounds of coal have been burned over any time interval.

Not only is the S-E-Co. Coal Scale accurate to ¼ of 1%, but it is completely modern in design — offering the maximum in reliable operation. Independent thinking and foresight have incorporated the following exclusive features as standard equipment in the S-E-Co. Coal Scale:

1. Counter that is electrically operated and, therefore, completely reliable and trouble-free. Easily mountable on remote central control station, if desired.
2. Unrestricted scale inlet with vertical skirt sides on feeder and with no baffles or other restrictions hindering coal flow through the scale.
3. Molded endless belt on self-contained feeder frame that can be removed from scale housing with unmatched ease and speed.
4. Standard frame motor with completely separate brake and gear reducer.

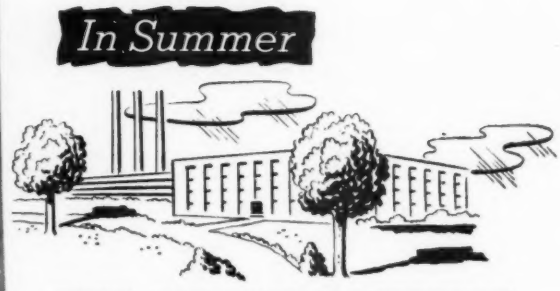
Write today for further details contained in our Coal Scale Bulletin or for a local representative to call on you and discuss our scale and other equipment.

Specialists in Bunker to Pulverizer or Bunker to Stoker Equipment

STOCK EQUIPMENT COMPANY
745P HANNA BUILDING CLEVELAND, OHIO

CLARAGE *Multitherm*
AIR CONDITIONING UNITS

THEY HEAT AND HUMIDIFY



THEY COOL AND DEHUMIDIFY

. . . . *year-'round comfort at low cost*

Clarage Multitherm Conditioning Units are double duty machines. They keep your place cool and dehumidified in summer. They heat and humidify in the wintertime.

You save considerable in cost by having the same equipment working for you the year-'round . . . and every day you're assured of comfortable working conditions.

Multitherm Units come in vertical and horizontal types as shown—ten sizes—capacities 600 to 20,500 c.f.m. You use a direct expansion refrigerant, cold water or brine for cooling; steam or hot water for heating.

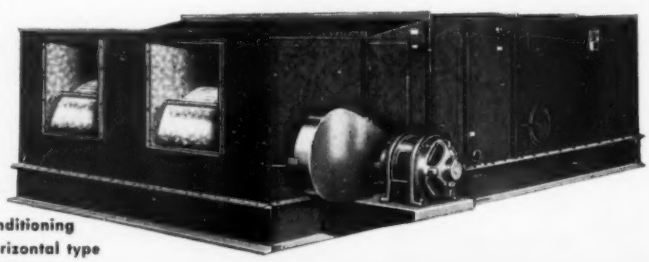
Multitherm Conditioning Unit—vertical type

. . . . *or process conditioning*

Aside from comfort applications in offices, plants, stores, etc., Multitherm Units are widely used in industry where production depends upon a certain temperature and humidity. Clarage Capillary Conditioners are available for cases where extremely close control is needed to meet requirements.

We welcome your inquiry for any desired information.

CLARAGE FAN COMPANY
Kalamazoo, Mich.



Capillary Conditioning Unit—horizontal type

You can Rely on . . .

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA Canada Fans, Ltd., 4285 Richelieu St., Montreal

IT TAKES *SMALL* PIPING, TOO

to produce BIG STEAM!

IT PAYS TO GIVE *Pittsburgh Piping*

THE COMPLETE PIPING JOB

Piping for high-temperature, high-pressure stations is not all big, massive mains. Blowdown lines . . . even air lines carrying only about 100 psi are all parts of a chain—the links of which must be forged with equal skill.

Every engineer knows his biggest headaches are caused by "small" troubles. That's why, at P. P. & E., "little things" get great attention.

We test the molecular structure of weldments with the eagle eye of gamma rays . . . search for flaws with ultra-sonic sound . . . control annealing temperatures electronically—finally, install every part of a piping system, no matter how small, with the same degree of precision.

The end result is greater safety, higher efficiency, and longer service from a P. P. & E. installation.

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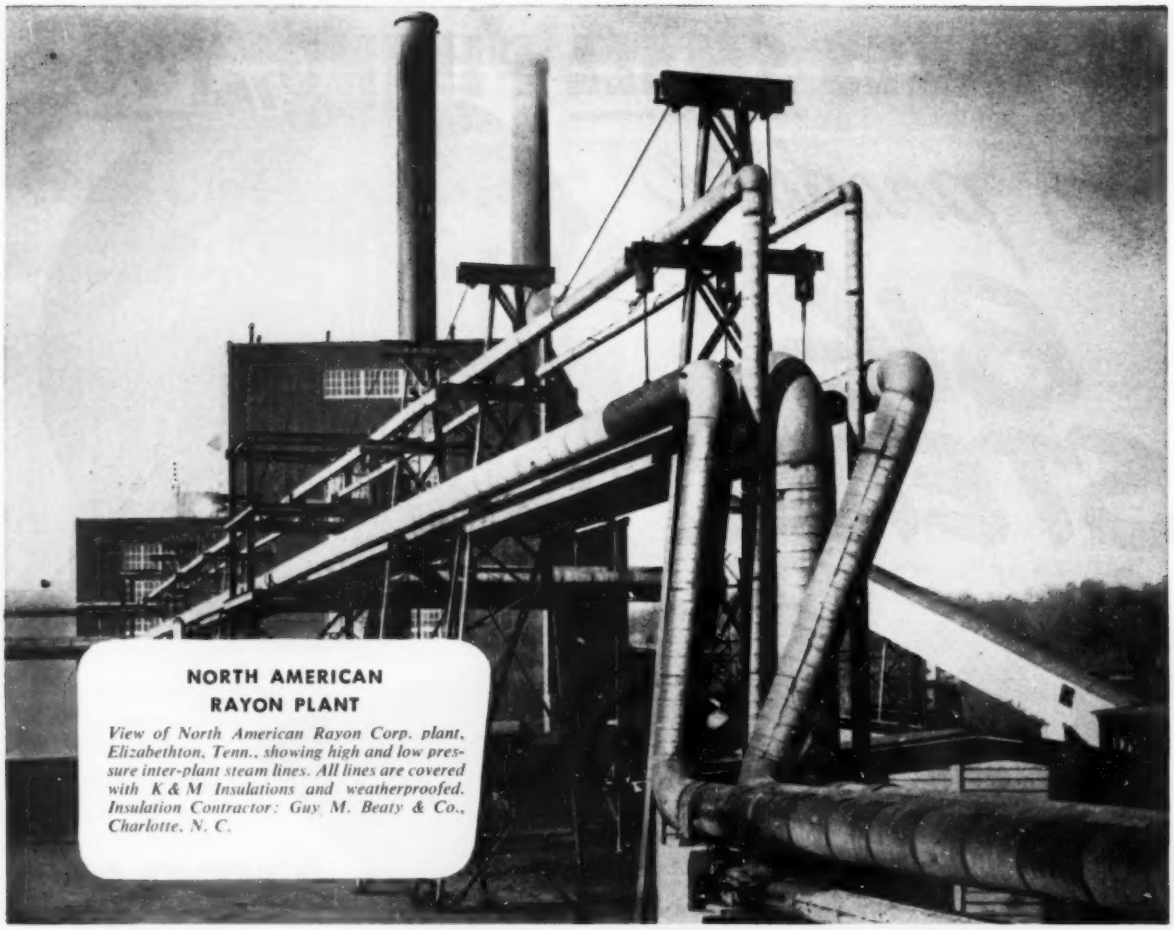

NORTH AMERICAN RAYON PLANT

View of North American Rayon Corp. plant, Elizabethton, Tenn., showing high and low pressure inter-plant steam lines. All lines are covered with K & M Insulations and weatherproofed. Insulation Contractor: Guy M. Beaty & Co., Charlotte, N. C.

Steam takes weather in stride
– under K&M Insulations!

THE steam lines pictured above run more than 2000 feet in the open air—exposed daily to sun, rain, and constant air-temperature change. Yet, because of efficient K&M Insulations, the steam travels these lines with minimum temperature loss. To the plant owners, that means power saved, money saved!

The two products that keep this heat within bounds are K&M Hy-Temp Insulation and "Featherweight" 85% Magnesia. Hy-Temp (diatomaceous silica) has exceptional heat-resisting qualities, and is put directly on the hot surface. A sufficient thickness brings its outside surface temperature to 600°F. or lower.

"Featherweight" 85% Magnesia, a superb insulator, is used as the second layer; and its surface may then be covered and painted, or weatherproofed for outdoor service, as in the illustration above.

K&M Hy-Temp and "Featherweight" in combination are effective on applications up to 1900° F. Two separate layers of insulation with vertical and horizontal staggered joints eliminate heat loss which occurs when expansion of hot piping and equipment causes joints to open in single layer installations. Both materials are made in a variety of sizes, shapes, and thicknesses to suit any application.

Your K&M Distributor is an experienced applicator who will gladly tell you more about these products. Or write directly to us.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
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Nature made Asbestos... Keasbey & Mattison has made it serve mankind since 1873

When Erosion, Wear, Fatigue or Corrosion is a problem —try **Monel!**

Let's take a look at a spot where Monel really has a tough job — to handle corrosive salt water!

This vertical salt water pump, and five others like it, pump a total of 144,000 gallons of salt water a minute. The water is used as cooling water in high temperature processing equipment. The pumps were made by PACIFIC PUMPS, INC., Huntington Park, Calif.

If you examined the metal used in one of these pumps, you'd find nearly a ton of corrosion-resisting Monel. Monel is used for the pump shaft and keys where its high strength and fatigue resistance insures a long and trouble-free life. You'll also find Monel discharge elbows, column tubes, oil tube and box, as well as bolts, studs and nuts. Monel-Clad Steel is used for flanges, column pipes and discharges. In fact, practically all surfaces contacting the corrosive salt waters are Monel!

For an interesting booklet on how Monel fights corrosion, write for your copy of "How to Get Longer Service From Your Pumps."

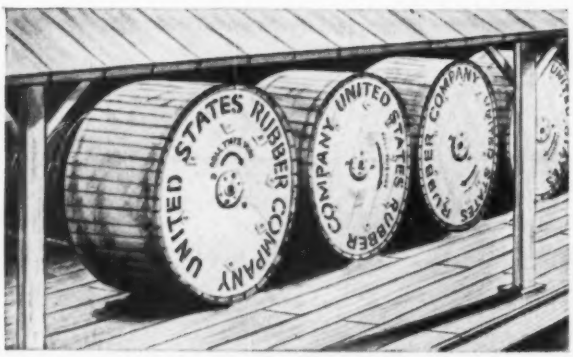
It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill. The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

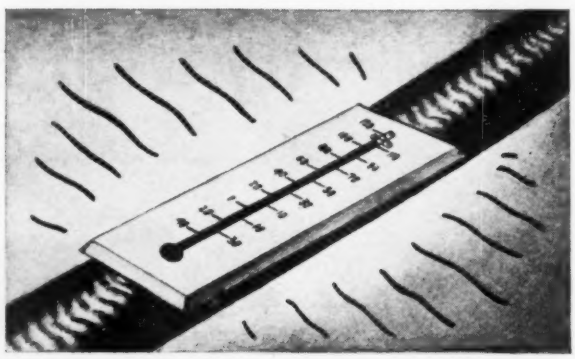
INCO

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"®
INCOLOY® • NIMONICS® • NICKEL
LOW CARBON NICKEL • DURANICKEL®

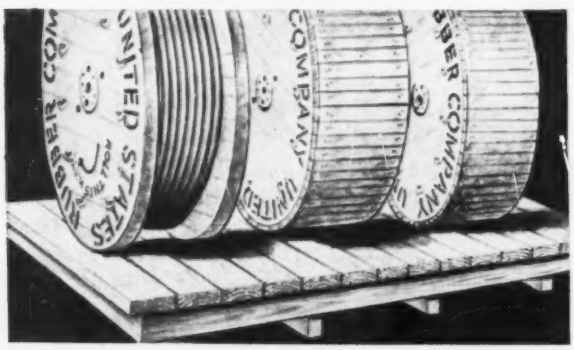
How to prolong the life of wire and cable by proper storage

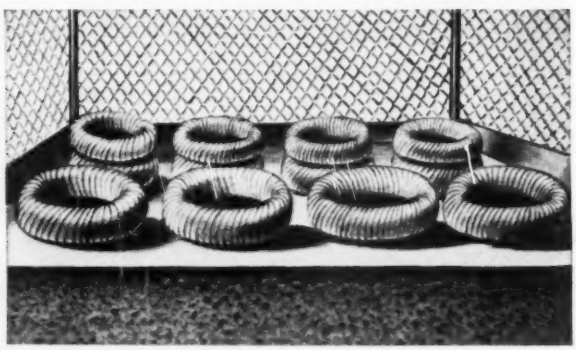




1 **Protect cables from the weather.** Moisture is especially injurious to fibrous coverings. When stored out-of-doors, if they become wet and then freeze, they will be weakened and the saturant will flake off. In humid weather, mold growth is accelerated, weakening the covering and making it easier to damage the cable during installation. (Rubber and thermoplastic insulated and jacketed cables may be stored under moderately humid conditions.) The larger sizes of fibrous covered and rubber jacketed cables and all lead-sheathed rubber insulated cables must be stored on reels which must be properly lagged—or the cable must be otherwise suitably protected against mechanical damage. Reels can be stored out-of-doors if the cable is protected against sun and weather, and the ends are properly sealed.

2 **Don't expose wires and cables to extremes of temperature.** Chemical reactions occur at a higher rate at high temperatures than low. The greatest deterioration of low-voltage cables is due to chemical changes, oxidation or internal changes in the compound itself. Never store reels in the boiler room unless you use a fan to blow hot air away from the wires and cables. It's best to store cables at room temperatures indoors out of direct sunlight. Rubber insulated cables may be stored and handled without damage at the lowest temperatures ordinarily encountered, but thermoplastic synthetic insulated cables should not be handled at temperatures below –10 C. (14 F.)





3 **Reels should be kept off the ground,** so that moisture will not harm the cables, reel flanges and lagging. Sound reels are easier to handle and there is less chance of injury to the cable as it is removed from the reel.

4 **Coils should be stored one layer deep on the floor or shelves,** with the axis either horizontal or vertical. To save space, they may be stacked, but not more than 5 coils in height—otherwise there is harmful pressure on the insulation. Don't remove brown paper or box that protects against dust and light until used.

5 **Rubber insulated fibrous covered, rubber jacketed or lead-sheathed cables in storage** should never be bent to a diameter less than I.P.C.E.A. recommended diameters. Never let coils or reels drop more than a few inches. Always roll a reel in the direction indicated by the arrow on the flange. When rolling an unlagged reel, put planks under the flanges to avoid pressure on the cable. Coils, reels and spools should always be rotated when wire and cable is removed to avoid twisting the cable.

FREE REPRINTS OF THIS PAGE ARE AVAILABLE. WRITE TO ADDRESS BELOW.

UNITED STATES RUBBER COMPANY

U.S.RUBBER
SERVING THROUGH SCIENCE

Electrical Wire and Cable Department

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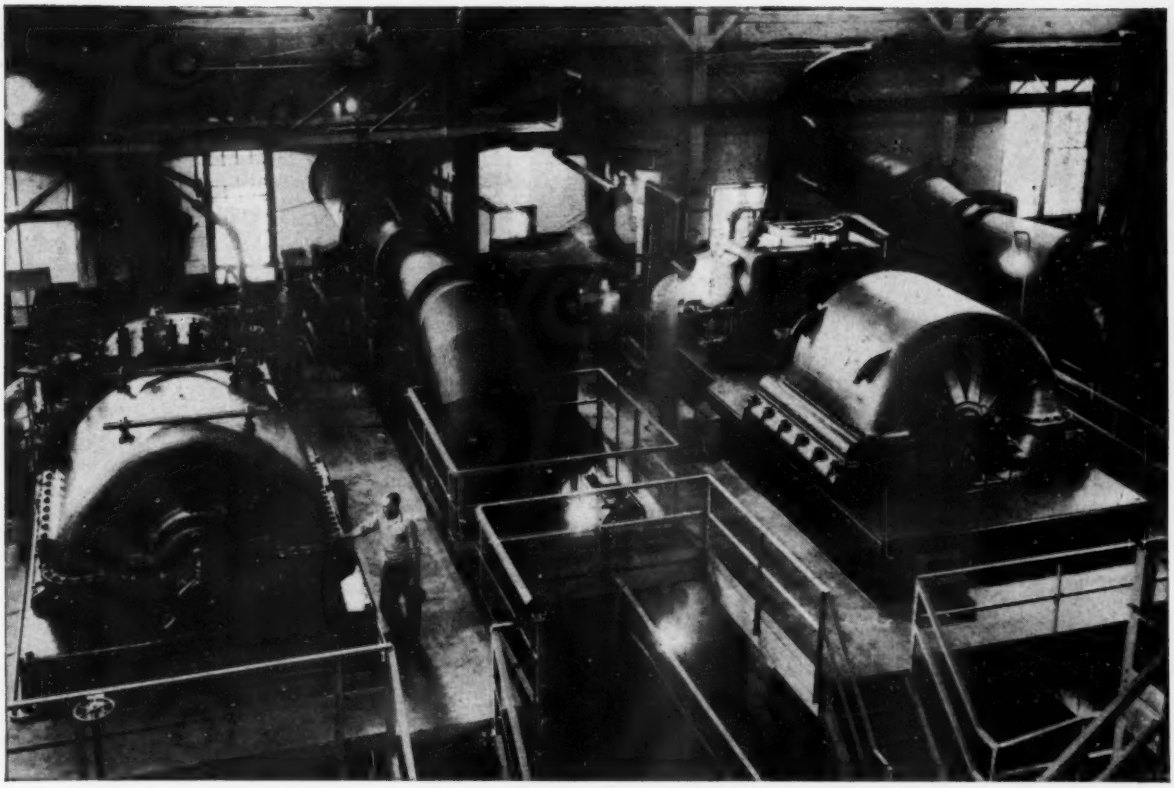


SECOND TURBO-BLOWER FOR SHARON STEEL—BY DRAVO

Twenty-five years ago, Dravo Corporation furnished the Sharon Steel Corporation's Roemer Works the first blast-furnace turbo-blower ever built by DeLaval Steam Turbine Company. Just recently installed by Dravo and now in service beside the original unit is a second turbo-blower of the same capacity. Both are 7,000-hp units, capable of delivering 60,000 cu ft of air per minute at 30 lb per sq in.

Dravo often serves as a "construction department" for utilities and industry . . . building complete power stations, boiler plants, water pumping stations, pipe-line facilities and water or waste treatment plants . . . on a single contract basis.

For more than 60 years Dravo has served business and industry in many fields of engineering activity. Why not inquire today as to how Dravo can be of service to you?

Write or call, Construction Department, Dravo Corporation, Fifth and Liberty Avenues, Pittsburgh 22, Pennsylvania.

THIS *too* IS DRAVO

Air conditioning · boiler and power plants · bridge sub-structures · compressor and pumping stations · crane cab coolers · docks, locks and dams · dredging · gantry and floating cranes · industrial foundations · marine repairs · open steel flooring · ore and coal bridges and unloaders · pipe prefabrication and erection · pump houses and intakes · ready-mixed concrete · river sand and gravel · river transportation · slopes, shafts and tunnels · space heaters · steel shipping containers · towboats and barges · water and waste treatment plants · DRAVO

Iron Fireman

Dual or Triple Fuel Firing

changes fuels quickly fires oil, gas or coal

Central of Georgia Railway cuts steam costs 37%— saves $16,939 a year

J. H. Grayson, Shop Engineer,
Central of Georgia Railway Company

"WE LIKE TO SAVE MONEY and Iron Fireman firing has shown us the way to do it," says Mr. Grayson. "The first year we installed Iron Fireman Industrial Gas Burners with Iron Fireman Pneumatic Spreader stokers as standby firing we saved nearly $12,000 on fuel. In addition, we also saved over $5,000 on labor costs and I can honestly say we enjoy steadier firing, improved operation, and constant steam pressure 24 hours a day."

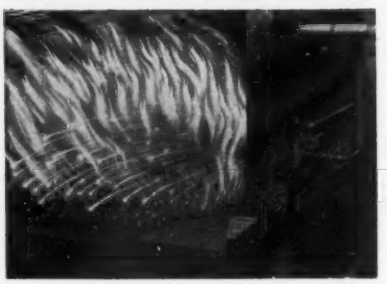
Burns all fuels efficiently

Efficiency ratings are high with oil, gas or coal. As price advantage shifts from one fuel to another your steam plant can shift with it—for the long pull if necessary. Or you can change fuels every day when desirable. This is routine practice in many companies where the gas supply is reduced during peak periods.

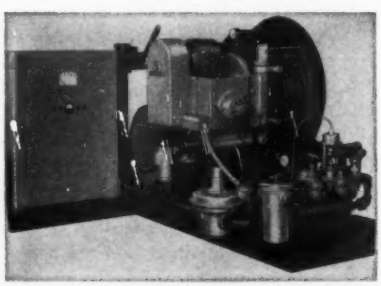
Avoid costly shut-downs

Fuel emergencies due to interrupted or short supply, can be disastrous. Yet protection may cost little or nothing when offset by the fuel and labor savings of Iron Fireman multiple fuel firing.

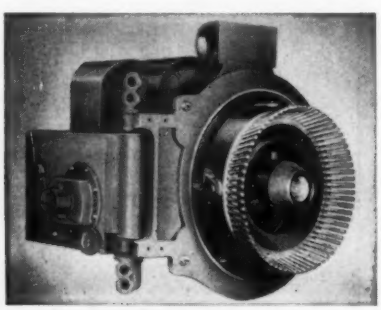
For further information write Iron Fireman Mfg. Co., 3043 West 106th Street, Cleveland 11, Ohio.



GAS, OIL, COAL. Equipment includes Ring Type gas burner, Rotary oil burner, and Pneumatic Spreader stoker. Coal is automatically dried, preheated and conveyed from bunker to boiler. No manual handling; no costly conveying equipment.



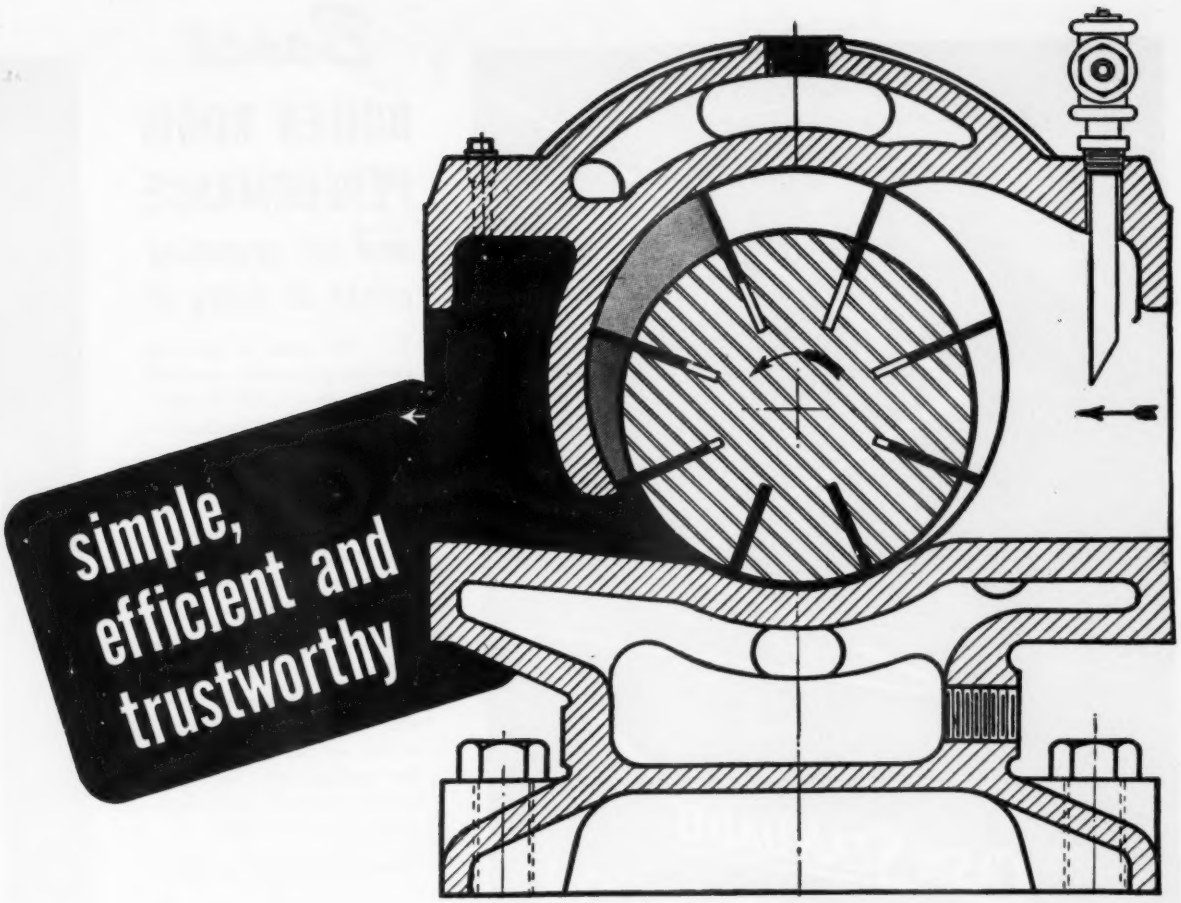
GAS-OIL PACKAGE UNIT. For Scotch marine and other types of boilers. Has integral forced draft and control panel which is completely wired and tested at factory.



GAS-OIL BURNER. Ring Type gas burner and Rotary oil burner on single mounting. Can shift fuels quickly with no loss of efficiency.

Iron Fireman

AUTOMATIC FIRING
FOR HEATING, PROCESSING, POWER



the FULLER ROTARY COMPRESSOR

For compressing gas, no reciprocating compressor can compare in simplicity and operation with a rotary.

PRINCIPLE IS SIMPLE

An eccentrically mounted, accurately machined rotor, with integral shaft, is supported on roller bearings in each of the heads. The eccentric rotor mounting leaves a crescent-shaped space, which is divided into compartments by wear-compensating blades. These slide freely in milled slots in the rotor, and are held, pressure tight, against the cylinder solely by centrifugal force. These compartments vary from minimum to maximum on the suction side, and from maximum to minimum on the compression half of the revolution. Properly designed blades, and a wide seal between rotor and bottom of cylinder, assure high and **maintained** volumetric efficiency; the multiple blades minimize pressure differences between compartments and contribute to maximum output with minimum wear.

OPERATION IS EFFICIENT

The Fuller Rotary Compressor assures a smooth flow, with no pulsations ... numerous displacement deliveries per revolution as against one in a single-cylinder piston compressor. Other advantages are: Direct drive; Compact installation; Simple foundations; Maintained capacity and efficiency; and No valves to leak. Because there are few moving parts —rotor, blades, and bearings, **maintenance time and costs are negligible.**

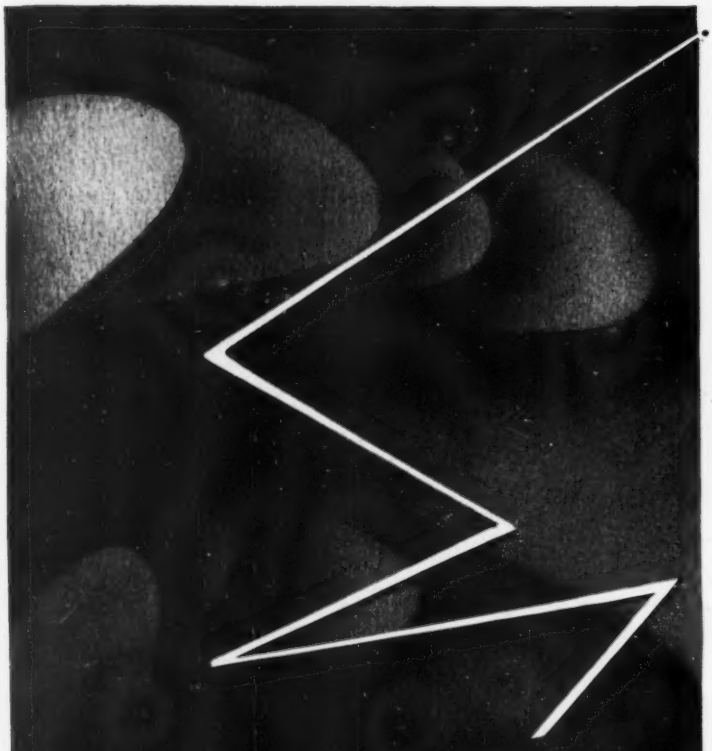
For further information on Fuller Rotary Compressors that will do a better job for you, write for Bulletin C-5.

Fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS • COMPRESSORS AND VACUUM PUMPS FEEDERS AND ASSOCIATED EQUIPMENT

FULLER COMPANY
Catasauqua, Pennsylvania
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

C-218



CASH STANDARD

AUTOMATIC COMBUSTION CONTROL SYSTEMS

IS NOT A COSTLY INVESTMENT . . . .

Boost

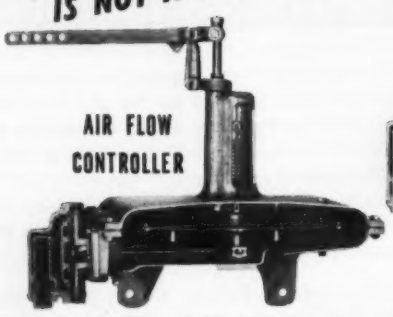
BOILER ROOM PERFORMANCE

and cut operating costs in doing it

The first step in gaining operating economy can well begin with a CASH STANDARD Automatic Combustion Control System. Then you at once establish savings such as: 1—in fuel (coal, oil, or gas), 2—in maintenance, 3—through the fact that you get more steam from your present boiler using less fuel.

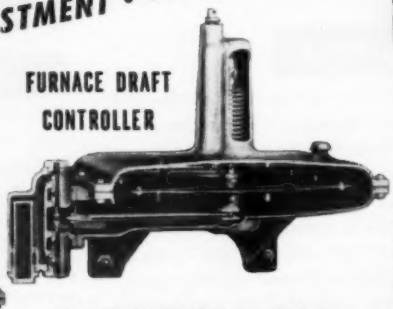
Whether you have a single boiler or battery of boilers you can get the desired economy results. The reason is you constantly maintain the correct fuel feed — the correct fuel-air ratio and correct over-fire draft.

Send for Booklet No. 300



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from over-fire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

A. W. CASH COMPANY

DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

Unaffected even after weeks under water*

UNIBESTOS®

PIPE INSULATION

*UNIBESTOS IS RUGGED. IT STAYS ON THE JOB

UNARCO

UNION ASBESTOS & RUBBER COMPANY

DEPT. C-6, 332 SOUTH MICHIGAN AVENUE, CHICAGO 4, ILLINOIS

PENBERTHY Liquid Level Gages

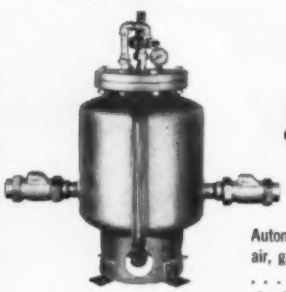
YOU CAN *Remove and Replace Without Shutdown*

Union connections between the gage and the valves permit removal of gage for repairs without shutting down the equipment. Just close the valves, uncouple the unions and remove the gage. The convenience of this is obvious. When glasses have to be replaced or repairs made, it is not necessary to work in an awkward position or to shut down. Another advantage: a gage needing repairs can be replaced immediately by a spare and the repairs made at leisure. There are many other reasons for the superiority of Penberthy Liquid Level Gages; ask for Catalog 35.

OTHER PENBERTHY PRODUCTS

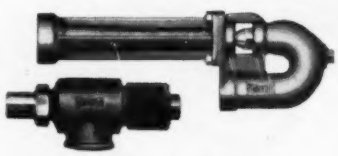
PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction —liquid chamber machined from solid block of metal. Ask for Catalog 35.



PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS

Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

4672

PENBERTHY INJECTOR COMPANY

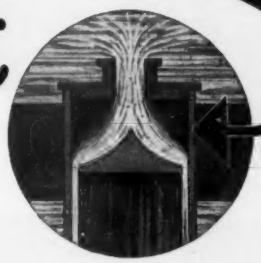
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

Dirty Water can't "Shut-down"...

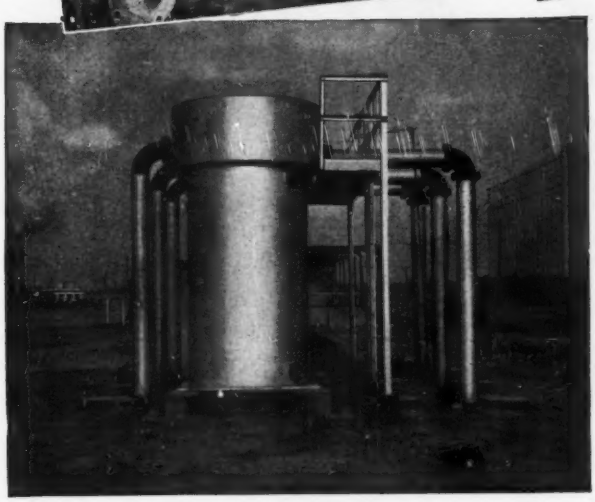
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

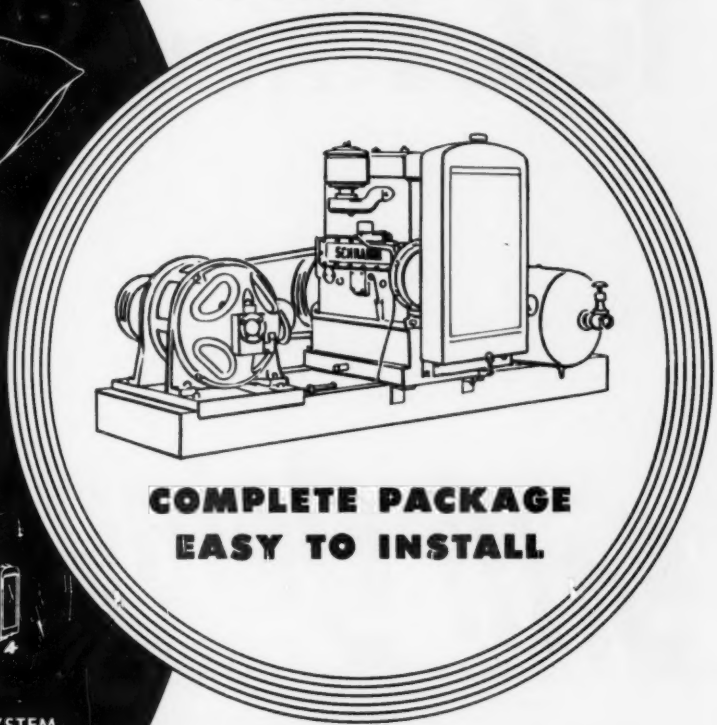
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

SCHRAMM
STATIONARY COMPRESSORS

For over 53 years SCHRAMM, INC., has devoted its entire resources exclusively to the manufacture of air compressors. This background and experience is reflected in the complete package featured here.

In addition to furnishing the size compressor, the correct type drive and mounting to fill every industrial requirement, you can also get all of the necessary accessories for a complete installation. Available in a compact package, easy to install and capable of furnishing 24-hour continuous service.

Built in sizes ranging from ½ to 100 horsepower. Write for Catalog 5110-A.



COMPLETE PACKAGE EASY TO INSTALL

SCHRAMM, INC.

The Compressor People

WEST CHESTER, PENNSYLVANIA

SCHRAMM, INC., WEST CHESTER, PA.
Please send Free Catalog 5110-A on installing Stationary Air Compressors.

Name_____

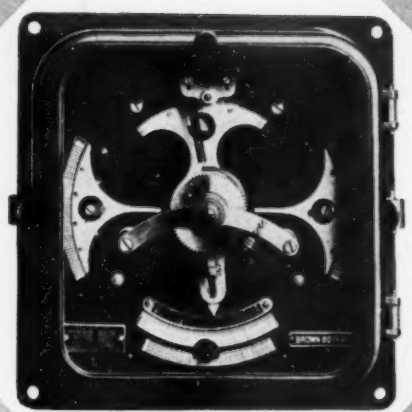
Title_____

Company_____

Street_____

City_____ Zone_____ State_____

INSTALLED in 1927... and



until it was returned for the first time to the factory shops for minor servicing in 1953, it required no maintenance other than periodical "air dusting".

Still going Strong!

While this may appear remarkable, it is not unusual. Brown Boveri Generator Voltage Regulators are installed and promptly forgotten . . . because they can operate for long intervals with no maintenance.

Its record in a Pennsylvania Power Plant is typical of the trouble-free service users get from . . .

BROWN BOVERI GENERATOR VOLTAGE REGULATOR

GET THE FACTS about these remarkable voltage regulators for AC or DC service. Precision built. Completely self-contained, no auxiliary units. From 1 to the highest kVA outputs. FAST DELIVERY — 1 MONTH OR LESS. SEND FOR DATA, TODAY!

BROWN BOVERI CORP.
19 Rector St., New York 6, N. Y.

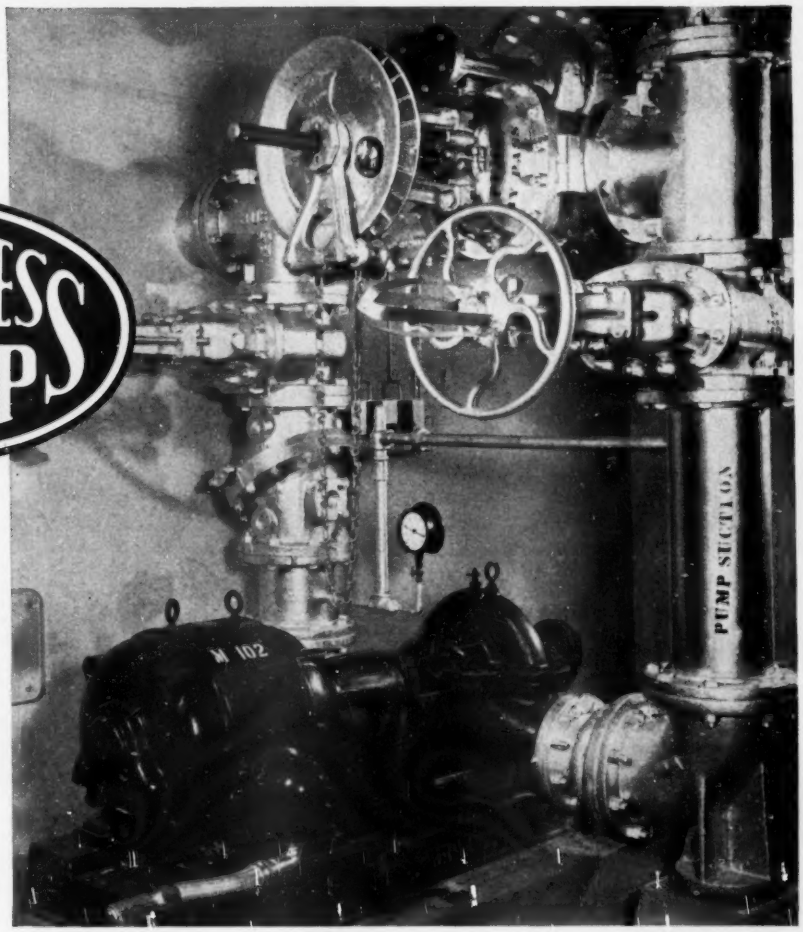
BROWN BOVERI

Peerless DEPENDABILITY

STOPS *Pump Troubles*

BEFORE THEY START—

PEERLESS PUMPS



PEERLESS TYPE A SINGLE STAGE, SPLIT CASE HORIZONTAL PUMPS

General Characteristics

CAPACITIES: Up to 70,000 g.p.m.

HEADS: Up to 300 feet.

DRIVES: Direct-connected electric motor; belted drives; diesel, natural gas, and gasoline engine; steam turbine; combination drives.

TEMPERATURES: Handles liquids up to 300°F.

DOUBLE & SINGLE SUCTION: (Double Suction Sizes 1¼" through 48"; Single Suction Sizes 2" & 3").

BOTTOM SUCTION: (Bottom Suction Sizes 12" through 42").

BALL BEARING: Radial and thrust bearings.

THE QUALITY PEERLESS BUILDS IN *is returned to you in service*

TYPE A *for All purpose pumping* —Peerless Type A pumps can be used in the widest variety of general pumping services, handling water and light alkaline fluids, where no solids are in suspension.

TYPE A *for Advanced design*— Peerless Type A pumps are of the ball bearing type with horizontally split cases, for ease of inspection and maintenance. All are furnished with double suction impellers.

TYPE A *for All capacities and heads*— Peerless Type A pumps offer users greatest range in capacities, delivering up to 70,000 g.p.m. Type A characteristics permit pumping against heads up to 300 feet.

TYPE A *for Ample safety factor*— Oversize shafts, heavy duty ball bearings, wear rings and shaft sleeves all contribute to ample protection against wear, afford a high factor of safety in operation and assure reliable service and extended pump life.

TYPE A *for Augmented service life*— Type A pumps are fully tested in Peerless' modern hydraulic testing laboratory, which can duplicate the field conditions under which the pump will be used. Experienced Peerless trained engineers, located near you are at your service to see that the Type A pump matches or exceeds your requirements.

TYPE A *for Accuracy in construction*— Bearing seats are cast and bored integral with the case, assuring permanent alignment. Parts are machined to gage on an interchangeable part system.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles, Calif. and Indianapolis, Indiana.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Tulsa; Dallas; Plainview; and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

PEERLESS PUMPS fmc

••••MAIL COUPON FOR BULLETIN

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send a copy of Type A Bulletin No. B-1300.

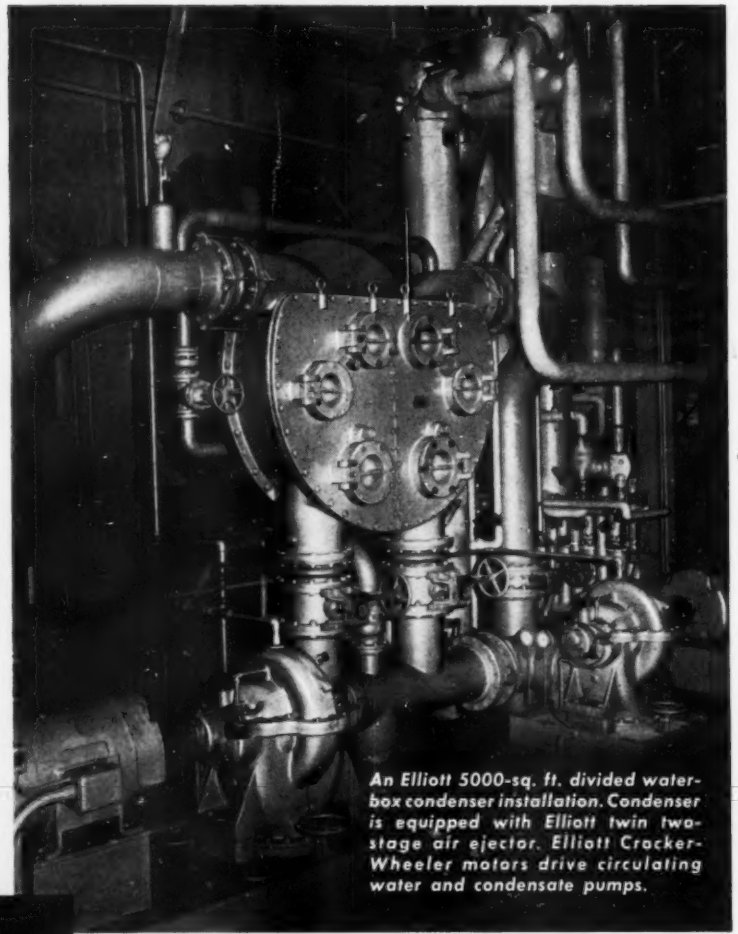
NAME_____

COMPANY_____

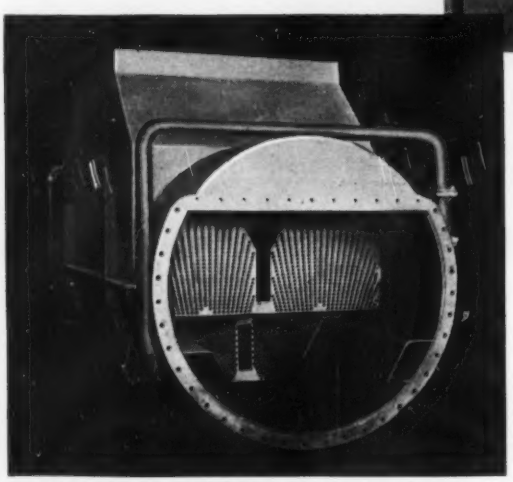
ADDRESS_____

CITY_____ STATE_____

Elliott careful engineering builds better condensers



An Elliott 5000-sq. ft. divided water-box condenser installation. Condenser is equipped with Elliott twin two-stage air ejector. Elliott Cracker-Wheeler motors drive circulating water and condensate pumps.



This view of a 10,000-sq. ft. condenser with tube plate removed shows the fan type tube layout, partial tube supports, and air intake baffles.

THIRTY-FOUR YEARS of step-by-step development are back of the Elliott Type F Surface Condenser, and have resulted in a number of advances providing for better, more efficient operation. The most important of these results are:

1. *Maximum penetration of steam, with minimum pressure drop, due to improved tube layout.*
2. *Condensate temperature equal to steam temperature.*
3. *Minimum oxygen content of condensate.*
4. *Minimum terminal difference – the temperature difference between steam in the top of the condenser, and the discharge water.*

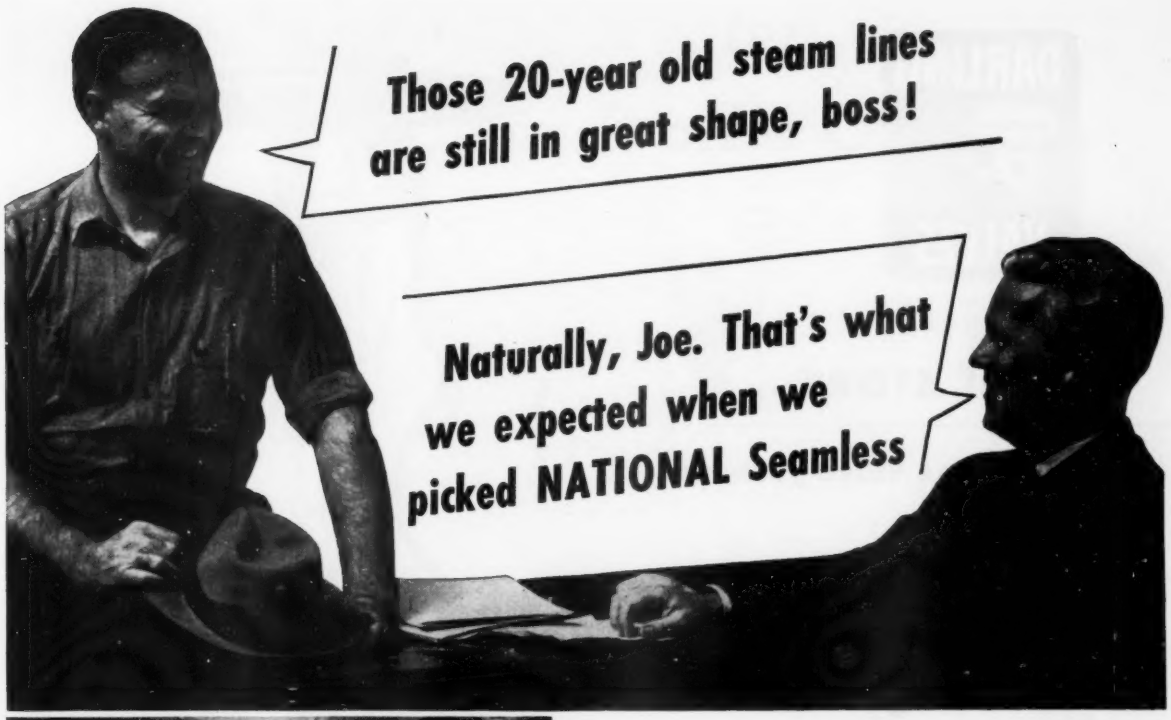
A further advantage in Elliott Type F condensers is the partial tube support design, in which support plates for the upper and lower tube banks are staggered rather than continuous, and thus do not divide the condenser chamber into cells, causing excessive pressure drop or dead spaces.

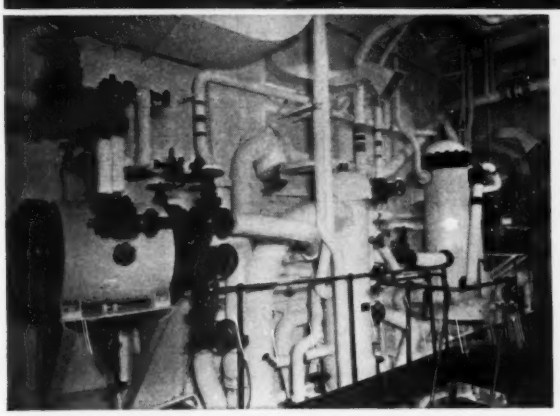
Type F condensers are built in sizes from 500 to 15,000 sq. ft., in both divided and undivided water-box type. They can be designed to meet specific space conditions. For details, contact your local Elliott engineer, or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

CONDENSER DEPARTMENT

C3-1


Those 20-year old steam lines are still in great shape, boss!
Naturally, Joe. That's what we expected when we picked NATIONAL Seamless



THE inspector's report is typical. For long, trouble-free service is the rule—not the exception—whenever National Seamless has been installed.

Recognizing this fact, and because high-pressure steam lines are the life lines of the modern steam plant, engineers everywhere are playing safe with National Seamless, the pipe that's pierced from solid billets of finest quality steel.

Every length of National Seamless Power Plant Piping is an homogeneous, soundly formed steel cylinder. There is no weld . . . no line of potential weakness to jeopardize the dependability of your lines.

Whether you are building a new plant, or just repiping present installations, National Seamless will give you longer, safer, more economical service.

Here's why **NATIONAL SEAMLESS** *is the preferred power plant piping.*

STRENGTH. Ultimate strength to meet any present specification requirements or more as required.

DUCTILITY. Meets requirements for flanging, bending, expanding, coiling, and similar purposes.

CREEP STRENGTH. Available in many grades of steel to assure maximum creep strength for the operating temperatures encountered.

CORROSION RESISTANCE. Various grades of steel from plain carbon to U·S·S Stainless according to service requirements.

HEAT RESISTANCE. Various heat-resisting alloys for higher temperatures and special conditions.

WELDABILITY. Readily weldable with the proper types of welding rods.

UNIFORM WALL STRENGTH. The seamless process stands alone among all processes of pipe making as the one method that removes all uncertainty regarding uniform wall strength.

Write for Bulletin No. 26, "Pipe and Tubes for Elevated Temperature Service," to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL *Seamless* POWER PLANT PIPING

UNITED STATES STEEL

DARLING VALVES

INSIDE STORY...

on trouble-free valve performance

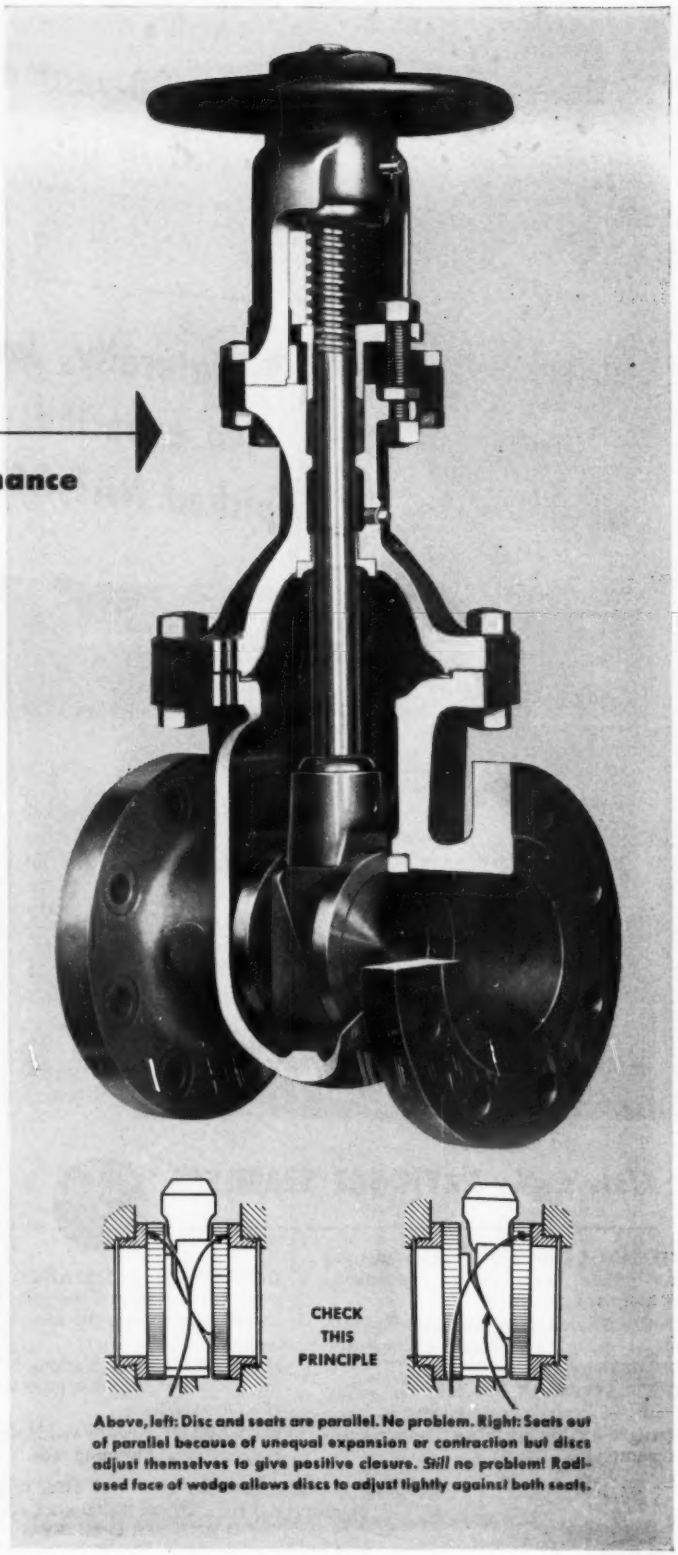
Install DARLING Revolving Disc GATE VALVES

Just what the doctor ordered . . . that's what users say about Darling fully revolving double disc, parallel seat gate valves. *Reason:* These unique valves adjust automatically to compensate for valve body distortion.

Moreover, Darling gate discs, independently hung from the upper wedge and free to revolve completely, change their seating position at each closing. This means uniform wear distribution. Valves work better and last longer, require less attention, less maintenance.

Wide Range Of Sizes And Types

If you're not already a Darling revolving disc gate valve user, let us prescribe the valve you need to cure *your* valve trouble. Darling gate valves come in a wide range of types and sizes . . . and for pressures up to 1500 pounds. Simply outline your particular service needs or ask for a complete descriptive bulletin.



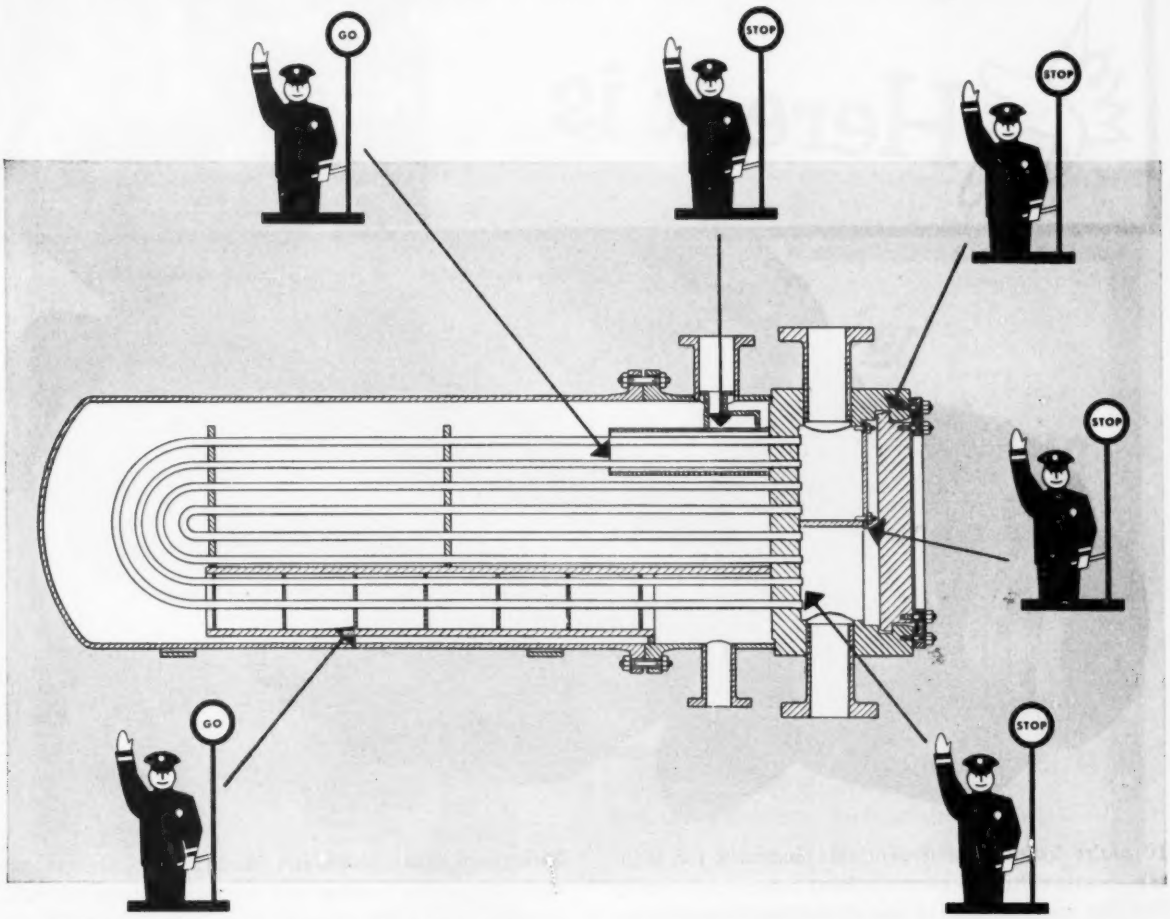
Above, left: Disc and seats are parallel. No problem. Right: Seats out of parallel because of unequal expansion or contraction but discs adjust themselves to give positive closure. *Still* no problem! Radiused face of wedge allows discs to adjust tightly against both seats.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

The Feedwater Heater with Complete Traffic Control



Traffic control in a feed water heater? Quite necessary, when you consider how inefficient the heating effect would otherwise be. Imagine the confusion of eddy currents and the consequent severe tube erosion if the steam entered without proper guidance.

In G-R Feedwater Heaters, control of both steam and water is complete and effective—the result of three quarters of a century's experience in the design of heat transfer apparatus by The Griscom-Russell Company.

Where the steam enters these G-R Heaters, its flow is first directed by an impact baffle; and when necessary, by a specially designed desuperheating enclosure before continuing its course through the heater. When sub-cooling is desired, the condensate is further guided through a sub-cooling zone before draining through the shell outlet.

Not only the steam in the shell, but also the water in the tubes is under constant control. Leak-tight tube joints and properly designed gasket joints throughout insure the safe routing of the water through the tubes.

Write for bulletin describing these control measures in detail. It also gives many other reasons why G-R Feedwater Heaters should be your choice, whether for low, medium or high-pressure service.

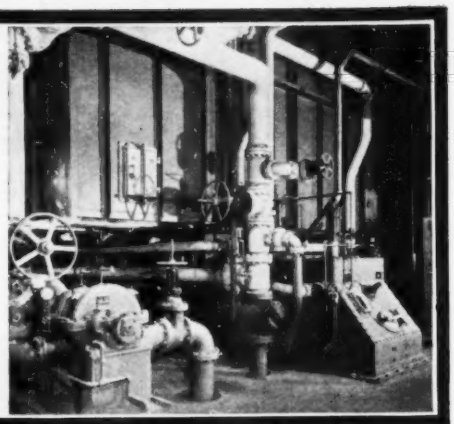
THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS **Feedwater Heaters**

GR 316

Looking for an Economical Bolting Combination?

Here it is



If you're looking for dependable fasteners for high-temperature, high-pressure bolting jobs, you'll surely like the combination of the Bethlehem Continuous-Thread Stud and two Bethlehem Quenched Nuts. This effective trio proves its economy in two ways: (1) It resists premature fatigue failure induced by fluctuating temperatures and pressures, and (2) It helps to minimize costly down-time.

Bethlehem Continuous-Thread Stud. Ideal for difficult bolting applications because it minimizes stress-concentrations. The stud has no point of thread-runout, therefore stresses cannot strike at any one point to cause premature failure. Instead, they are effectively distributed along the full working length of the stud. The continuous-thread stud is made from carbon or alloy steels, and comes either plain or heat-treated. You can count on it for long service.

Bethlehem Quenched Nut. Made from .40 to .50 carbon steel by forging and extruding hot steel in a forming die, then quenching and tempering. This process enables the nut to develop the full strength of any stud or bolt.

Both the Bethlehem Continuous-Thread Stud and Quenched Nut are made in a full range of sizes. They make a long-lasting bolting team. If you would like additional information about this bolting combination, the nearest Bethlehem office is at your service.

Made at Lebanon Plant... Key to Quality

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

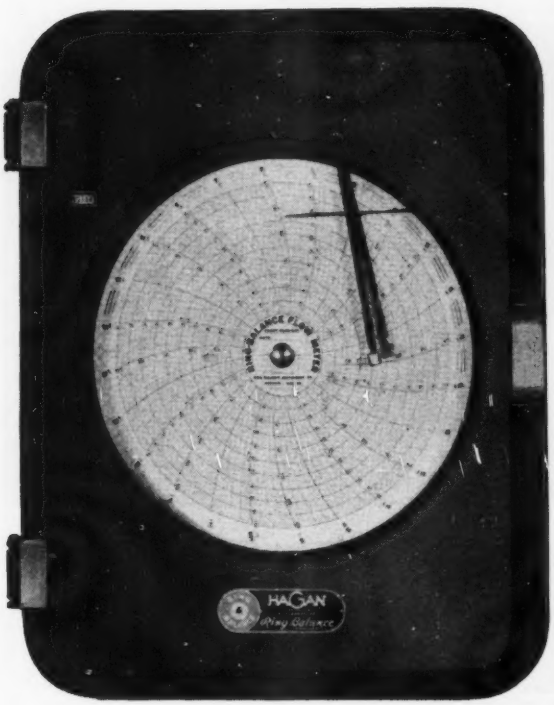
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bethlehem supplies every type of Fastener

For accurate, automatic compensation
for temperature—
for pressure—
for density—or for position

Install Hagan Compensated Ring Balance Meters



The Hagan Compensated Ring Balance Meter automatically adjusts pressure differential or flow readings to correct for variations in temperature, pressure, density or mechanical positioning.

For flow measurements, the built-in integrator totalizes the corrected flow automatically.

Any measurements, such as drum level, steam flow, or any of the variants such as temperature, pressure, or density may be indicated or recorded on the same chart with the corrected record.

Send coupon for Bulletin M-51.

HAGAN CORPORATION
HAGAN BUILDING, PITTSBURGH 30, PA.
Boiler Combustion Control Systems
Ring Balance Flow and Pressure Instruments
Metallurgical Furnace Control Systems
Control Systems for Aeronautical
and Automotive Testing Facilities

Hagan Corporation
Hagan Building • Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in _____

_____

NAME _____

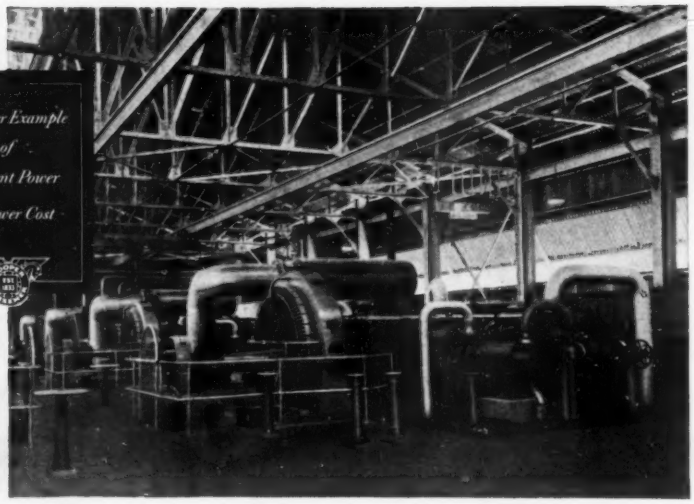
POSITION _____

COMPANY _____

STREET AND NUMBER _____

CITY _____ ZONE ____ STATE _____

P-6



Cooper-Bessemer

MODERN DESIGN...

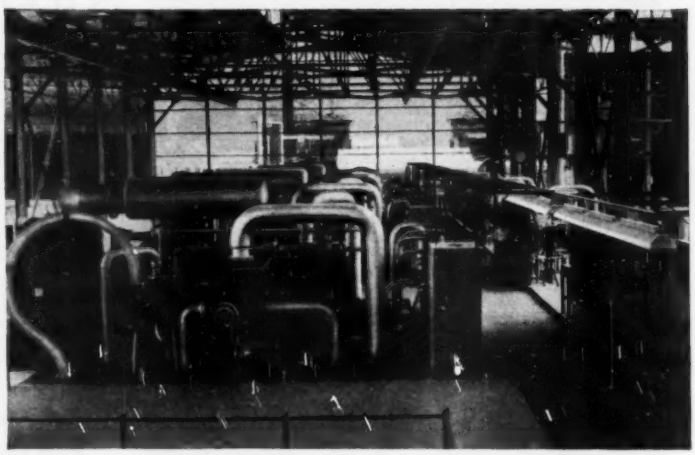
for compressors at Sindri . . . at Suez . . . everywhere!

● Shown opposite are Cooper-Bessemer motor-driven compressors in two of the world's newest and largest synthetic ammonia plants.

The top view shows part of the 22,000 Cooper-Bessemer M-Line compressor horsepower installed in the ammonia synthesis plant of the Sindri Fertilizer Factory, Bihar Province, India. Here, ammonium sulphate can be produced at a rate of 1,000 tons a day — 350,000 tons a year!

Similarly the other photo shows a line-up of Cooper-Bessemer compressors in the large Suez plant of the Societe Egyptienne D'Engrais et D'Industries (S.A.E.), Egypt. Here, calcium nitrate fertilizer is produced at a rate of 200,000 tons yearly.

In both plants, these modern Cooper-Bessemer units handle the entire compressing job and comprise the heart of production operations. For, with Cooper-Bessemers, you can be sure of year-in, year-out performance at the lowest operating cost.



Cooper-Bessemer M-Line motor-driven compressor in the synthesis section of the Sindri Fertilizer Factory, India. Here eight 2,750 hp 7-cylinder units compress gas through six stages to a pressure of 5,500 psi. The huge Sindri plant was engineered by the Chemical Construction Corp., New York, and built under the direction and supervision of the Power-Gas Corp., Ltd., England.

Here, in the Suez plant of the Societe Egyptienne D'Engrais et D'Industries (S.A.E.), these four 2,750 hp JM-5 motor-driven units compress 25,344 mcf of gas daily from atmospheric to 5,200 psi for initial calcium nitrate production of 200,000 tons yearly. This plant, engineered by the Chemical Construction Corp., utilizes waste gases from nearby oil refineries.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

Start these savings NOW...

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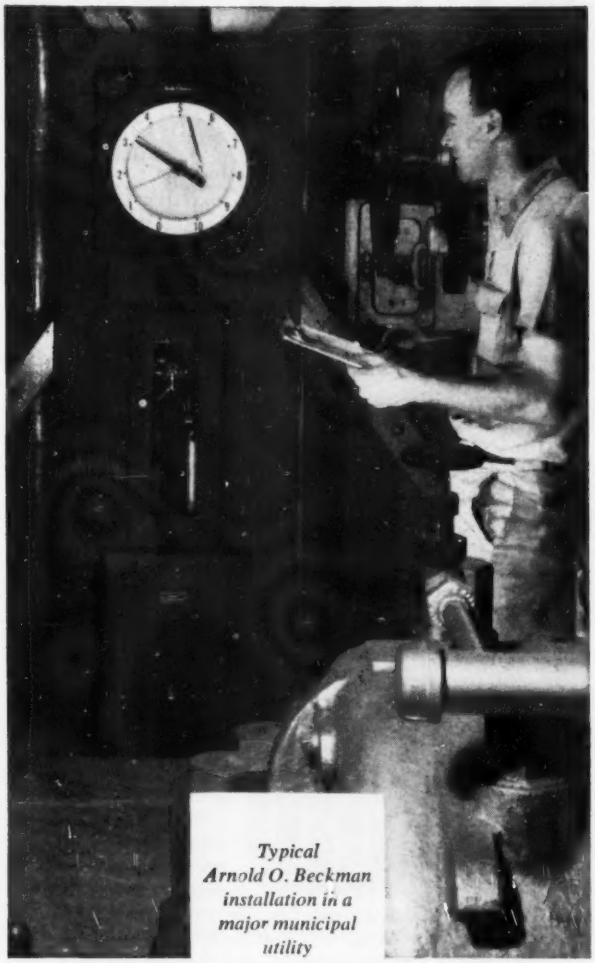
Arnold O. Beckman

MODEL F-3

OXYGEN ANALYZER



Typical Arnold O. Beckman installation in a major municipal utility

Save Fuel!

Buying fuel that goes up the stack unburned is buying lost efficiency and objectionable smoke. Insure *complete* combustion with a Model F-3!

Save Heat!

Excess air only wastes valuable heat. You *know* when to cut down on excess air with a Model F-3!

Save Upkeep!

Costs for operating and maintaining the Arnold O. Beckman Analyzer are negligible. Only periodic checking is required, and no special skill is needed to operate the F-3.

Get the full story on the many ways the Model F-3 Analyzer and Sampling System can benefit *your* operations. Write for Data File 5B-63!

Features of the Beckman Model F-3

SELECTIVITY Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

MANY RANGES Combustion ranges include 0-5%, 0-10%, 0-15%, and are provided with a second range of 0-25%. Other ranges up to 0-100% O_2 are available. Calibration of the Model F-3 is strictly linear and scale is accurate over the entire range.

HIGH ACCURACY ±1% of full scale for spans of 5% and greater. Accuracies within .05% O_2 on 0-5% range are available.

AIR CHECK Simple positive check of proper operation by recording the air point on the second range.

SIMPLE SAMPLING Independent of flow rate. Nothing is added to the sample. The sample may be dry or saturated. Corrosive gases will not poison the instrument. Only a small sample (3-15 cu. in./min.) is required.

LOW MAINTENANCE Completely insulated against extreme shock and vibration. No chemicals, no catalysts to replenish. No wicks, filaments, orifices, valves, etc., to clean and replace.

STANDARD RECORDERS Any standard industrial potentiometer recorder or pneumatic receiver can be used.

Arnold O. Beckman INC

Manufacturers of Industrial and Scientific Instruments

1020 MISSION STREET

SOUTH PASADENA, CALIFORNIA

NEW JERSEY PROCESS PLANT SAVES NEW FEED PUMP COST

Expansion plans called for a new boiler, and the Chief Engineer thought he'd need a new feed pump too. Pumps on hand — two 10 x 6 x 10's — often needed repairs to meet existing demand. Leaking valves kept them below capacity most of the time. He tried Sims Pump Valves before the new installation was completed and found, even at slower speeds, his pumps still supplied all the water necessary. When the new boiler was put on the line, the same pumps with Sims Valves carried the load easily.

Three years later the Chief said, "Sims Valves were a good investment." They were — but he couldn't lose anyhow. Sims Valves were *guaranteed* to give him better performance — complete satisfaction.

See how Sims valves can help with your pump problems. Carried in stock to fit over 40 different makes of reciprocating pumps — and hundreds of sizes — they'll fit your pumps — improve performance. Free catalog shows how.

SIMS
PUMP VALVE
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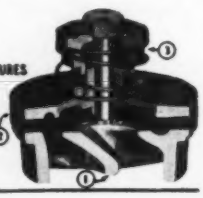
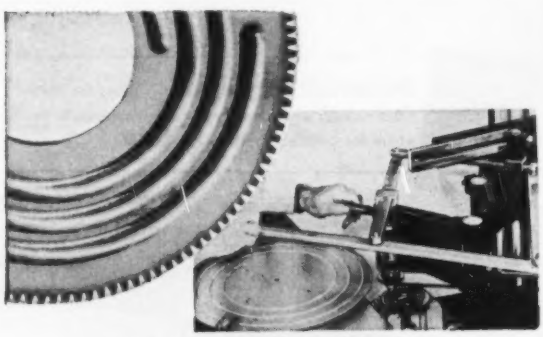
...Only **SIMS** HAS THESE PATENTED FEATURES

1. Inclined ribs, which help increase pump capacity 20%.
2. Valve disc that rotates every time it lifts
3. Double shock-absorber stem head.





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Catalog H58 Bench Type Model (weight 200 lbs.)
Portable Model IM also available

***Production:* 6" brass spiral with ¼" x ¼" groove cut from 3 times larger template**
***Time:* 12 units per hour.**

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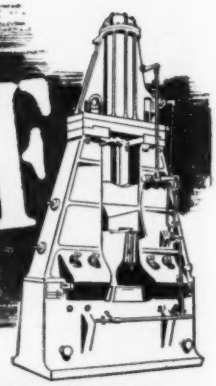
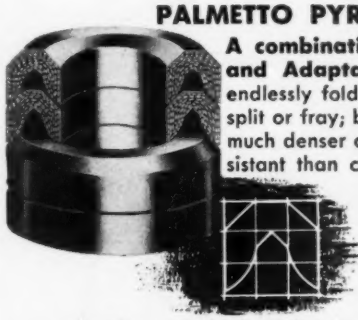
The PROOF of the PACKING ...is in the TESTING



Palmetto Pyramid: 17 to 7 — At the Canton Drop Forgings and Mfg. Co., a 5000 lb. Steam Drop Hammer was used to compare Palmetto Pyramid #2500 with a conventional square packing. Results: 24 lbs. of square packing were used in 7 weeks. After the initial packing — rings were added 2 or 3 at a time. This means approximately 3 complete sets of square packings in 7 weeks.

ONE SET OF PYRAMID #2500 (NO RINGS ADDED) LASTED 17 WEEKS!

PALMETTO PYRAMID



A combination of Strength and Adaptability. Made of endlessly folded fabric, it can't split or fray; being molded, it is much denser and more wear resistant than conventional packings; asbestos-reinforced, it can withstand temperatures of 600° F.; patterned on a square, each ring provides a solid base for the one above. This strength, combined with the flexibility of Palmetto Pyramid's design, provides the formula for real heavyweight service.

FOUR WAYS FLEXIBLE

1. Single-line contact — facilitates instant response to pressure changes.
2. Lip curve — provides free entrance for pressure medium, assures positive sealing action and thorough lubrication.
3. Lateral surface — is largely sealing surface. Means fewer rings — less friction — longer life.
4. Automatic sealing — means tighter sealing with increasing pressure. But no binding — for adjustment is self compensating through internal pressure.

Palmetto Pyramid not only can take it. It can take it longer. Because it *rides with the punches.* Send for catalog PC-102 covering complete Palmetto line.

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PALMETTO Packings

packing more performance into every application

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When buying gauges ask for USG . . . where a most diversified stock awaits your selection. USG Gauges are stocked for your convenience. You can order any of a wide variety of instruments—233 types, dial sizes, and size ranges—without delay. Many of these gauges are obtainable immediately from the local stock of distributors of USG Gauges in principal cities throughout the United States. Or they may be ordered through your USG distributor directly from factory stock at Sellersville, Pa. Take advantage of this fast delivery service. Call the distributor of USG Gauges in your locality today for information on gauges. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pa.

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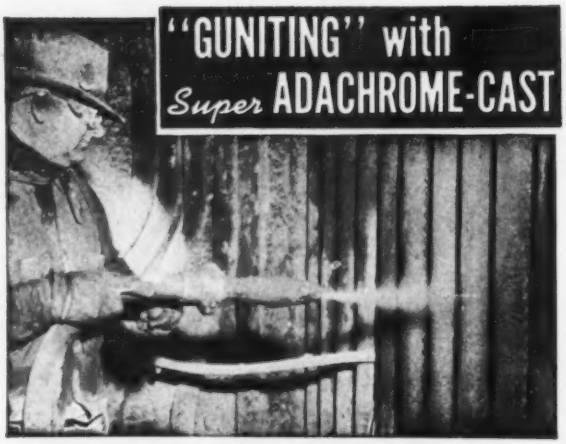
OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS

"GUNITING" with *Super* ADACHROME-CAST



Tradename "Guniting" courtesy Cement Gun Co., Allentown, Pa.

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Excellent for coating brickwork when free of slag.

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Yours, *FREE* for the asking . . . an illustrated, detailed Bulletin on *Super* ADACHROME-CAST.

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BURNS COAL AND/OR WOOD WASTES

Increases Boiler Capacity
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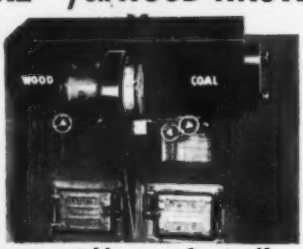

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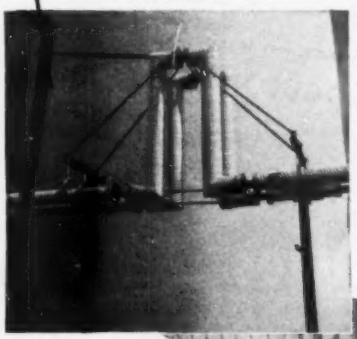
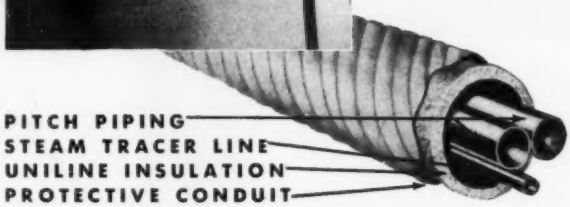
PIPING VISCOUS MATERIALS?

HERE'S HOW A Large Primary Aluminum Producer Solved Pitch Flow Problem with RIC-WIL UNILINE INSULATED PIPING



Design requirements for this overhead pitch handling system called for an insulated pipe conduit capable of heating the pitch from its solid state at 25° F to a minimum pumping temperature of 285° F. and maintaining this temperature.



THE temperatures required are efficiently maintained in Ric-wiL's Uniline System. Pitch piping is nested with a steam tracer line inside an insulation liner which insulates the pipes from the exterior but not from each other. The emission of heat from the steam tracer keeps the pitch in a free-flowing liquid state and at the desired temperature. The entire system is housed within a protective conduit of 16-gauge Armco ingot iron, helically-corrugated and hot-dipped galvanized.

Ric-wiL Uniline Systems are also used to maintain proper flow in piping oil, asphalt, molasses, and many other viscous materials — underground or overhead. Pipe lines subject to corrosive conditions may be coated with Ricwilite, a baked-on phenolic resin having outstanding corrosion resistance and durability.

Scientific design of Ric-wiL Insulated Piping, completely prefabricated with all accessories required, assures high thermal efficiency and speedy, low-cost installation.

- *Write for our latest catalog, or contact us for full technical information on Ric-wiL as applied to your piping problem.*

THE RIC-WIL COMPANY
Mfgrs. Insulated Piping and Conduit Systems
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LEADERS IN INSULATED PIPING PROTECTION

FREE

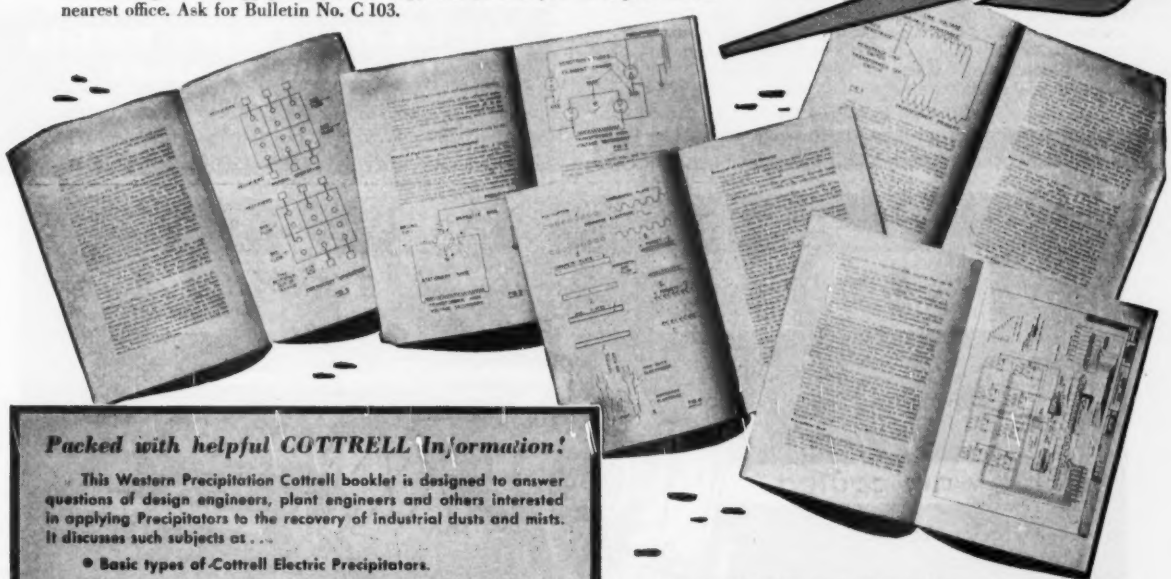
From Western Precipitation—the organization that pioneered the commercial application of Cottrell Precipitation...

28 PAGES of helpful facts to know about COTTRELL ELECTRICAL PRECIPITATORS

IF YOU ARE ENGAGED in any phase of industry where the recovery of dusts, fumes, fly ash, mists, fogs or other suspensions from gases is a problem, you will find this booklet on the COTTRELL Electrical Precipitator helpful and informative.

Western Precipitation pioneered and installed the first commercial application of the well-known COTTRELL Electric Precipitator—Dr. Cottrell, the inventor, being a member of the company. And for more than 42 years Western Precipitation has consistently led in developing new COTTRELL advancements and techniques for recovering suspensions from gases, both wet and dry.

This 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C 103.



Packed with helpful COTTRELL Information!

This Western Precipitation Cottrell booklet is designed to answer questions of design engineers, plant engineers and others interested in applying Precipitators to the recovery of industrial dusts and mists. It discusses such subjects at . . .

- **Basic types of Cottrell Electric Precipitators.**
- **Principal parts of a Cottrell Precipitator.**
- **Mechanical and Electronic Rectifiers.**
- **Various types of Collecting Electrodes (rod curtains, corrugated plates, dual plates, pocket electrodes, etc.).**
- **Removal of Collected Material.**
- **Factors in Shell Construction (steel, concrete, brick, etc.).**
- **Operating Efficiencies and the Effect of Various Factors on Performance.**

. . . and many other basic Cottrell facts. Write for your free copy of Bulletin C103 today while supplies are adequate!

Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

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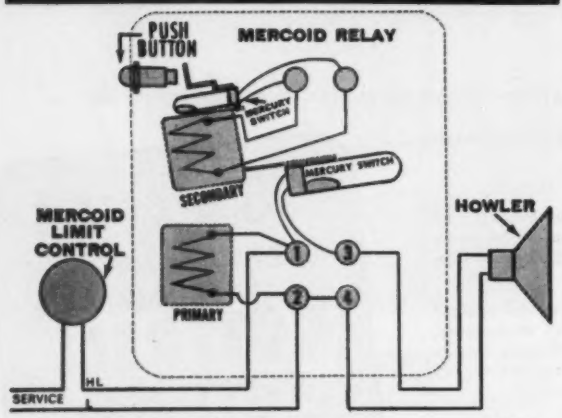
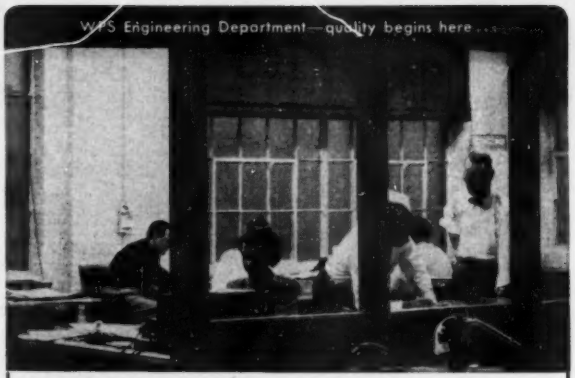
MERCOID RELAY FOR AUDIBLE ALARM



When Limit Control closes its circuit, current is supplied to primary coil of Mercoid Relay and through the normally closed mercury switch to the "Howler" (alarm). To stop "Howler," operator pushes in "push button" which manually raises relay secondary and breaks circuit to "Howler." Secondary is held up by magnetic repulsion until condition is corrected. When limit control opens the primary circuit of relay, secondary coil drops to normal position and relay is automatically ready for another operation.

WRITE FOR BULLETIN CA-8R

THE MERCOID CORPORATION 4201 BELMONT AVE. CHICAGO, ILL.



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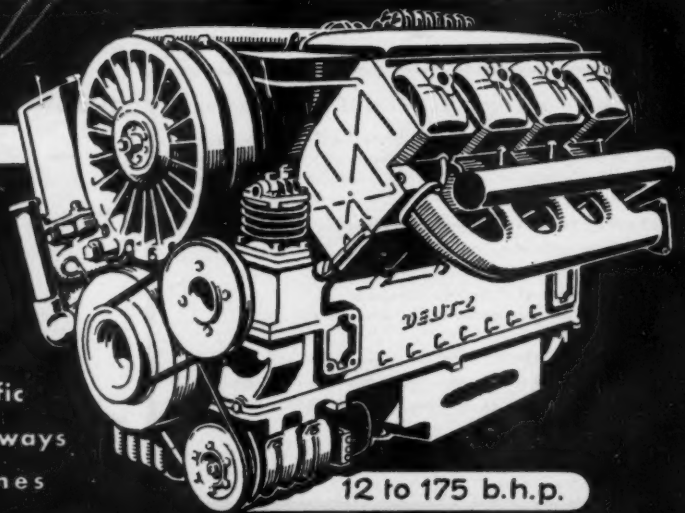

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This 200,000 gph hot lime-hot zeolite softener located at an eastern refinery is the world's largest installation.

GRAVER

SPHERICONE *Hot Process Water Softener*

In hot process water softening, the clarity of the effluent depends, among other factors, on the rising rate of the water through the unit... the greater the cross-sectional area, the lower the rates ... the lower the rates, the lower the turbidity. This lower turbidity means fewer filter backwashings and the very lowest labor costs.

The Sphericone, a Graver original design, offers a larger cross-sectional area per pound of steel used, and consequently per dollar invested, than the standard cylindrical type of hot process softener.

The expanding settling zone and larger cross-sectional area provide crystal clear effluent at rates, in many cases, up to 20-30% overload. These features, plus the Sphericone's high efficiency in silica reduction by contact with MgO sludge in a deep, dense blanket, make it one of the most important developments in the hot process softening field.

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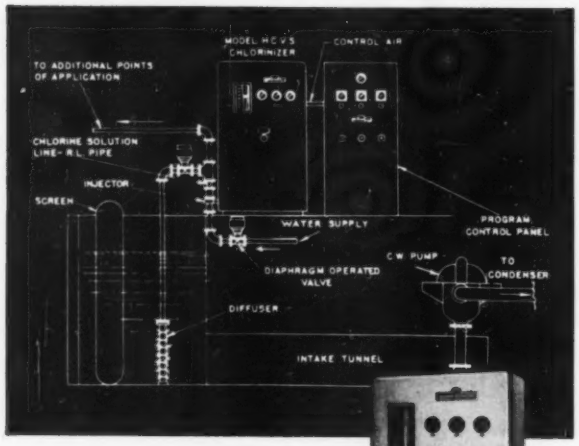
GW477

Slime Control
IN COOLING SYSTEMS



Chlorination — the modern way to prevent slime buildup in condensers and heat exchangers — saves you money if it's right. But if dosage is too heavy, you run the risk of corrosion . . . or if it's too light, chlorination is worthless.

Builders Chlorinizer is the key to safe, effective, economical chlorination in cooling systems. CHLORINIZER IS ACCURATE . . . The sensitive compensating valve and the visible-flow Sightflo Indicator guarantee correct feed for effective treatment and insure against corrosion. CHLORINIZER IS SAFE . . . The full vacuum principle automatically and positively shuts off chlorine feed on loss of vacuum. CHLORINIZER IS SIMPLE . . . Because of its basic design, Chlorinizer is readily adaptable to single or multiple point applications on manual, semi-automatic, or fully automatic control.

Builders Chlorinizers are available in three volumetric models for feeding from a few pounds to 6,000 pounds per day. Send coupon for complete details.

BUILDERS-PROVIDENCE, INC.

(DIVISION OF B-I-F INDUSTRIES)

354 Harris Avenue, Providence 1, Rhode Island

Please send Application Memo No. 840-J9 describing Chlorinizer slime control system.

Name.....

Company.....

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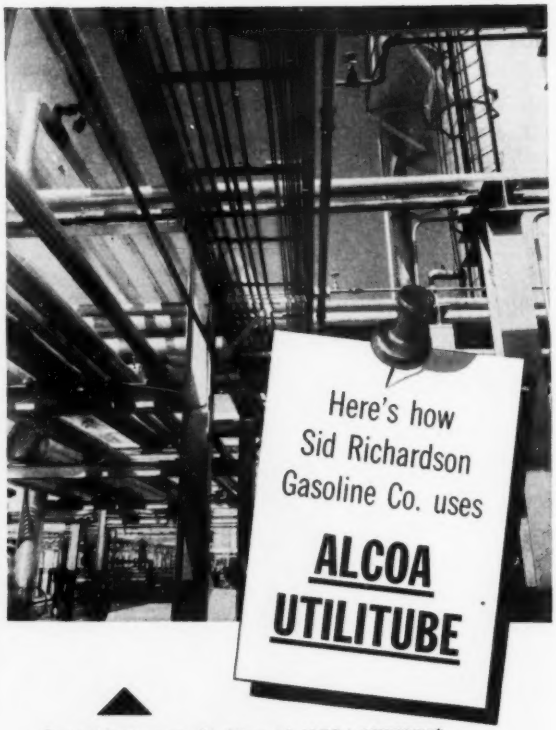
City..... State.....



Control-Instrument Air Lines of ALCOA UTILITUBE* at Keystone Plant, Kermit, Texas. Exposed to hydrogen sulfide fumes since installation in 1948, aluminum tubing and fittings have required no maintenance, show no apparent corrosion. Air, dried by Alcoa *Activated Alumina, operates at 80° F and 25 psig.**

ALCOA UTILITUBE is aluminum coiled tube made of a specially selected alloy to provide low cost, easy workability and high fatigue strength.

ALCOA Utilitube offers savings up to 40 per cent over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

In petroleum service, ALCOA Utilitube will not form sludge or gum . . . will not discolor or contaminate the fluid it carries.

ALCOA Utilitube is versatile. Use it for air for pneumatic and hydraulic control circuits and brake lines—gasoline and fuel oil for internal combustion engines—lubricating oils for engines and machines —fluids for hydraulic systems.

For complete details, write for the new booklet: "Alcoa Utilitube."

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Alcoa Aluminum

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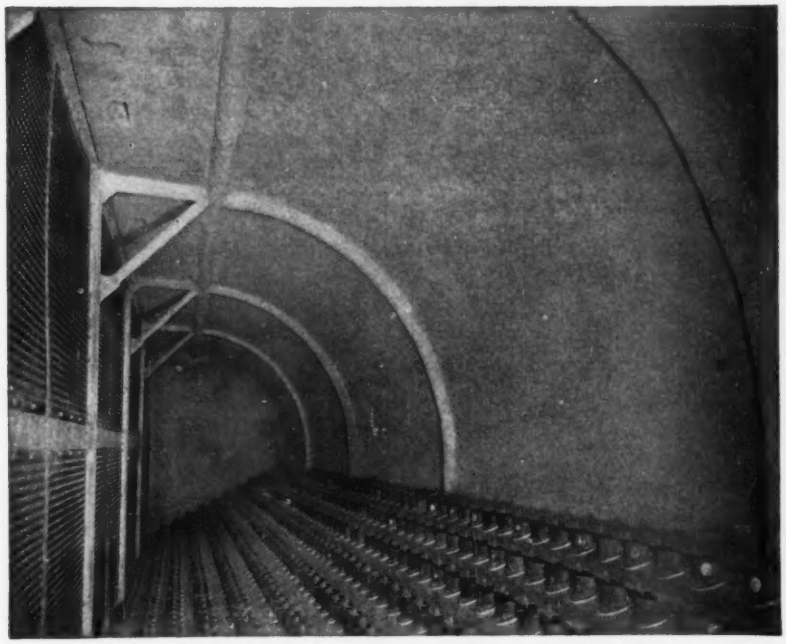
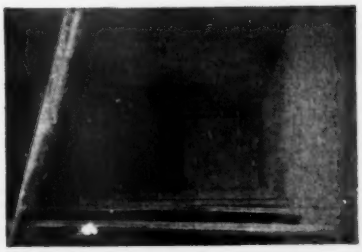


TOUGH—Inside view of a giant multiclone dust collector Gunite-lined with Lumnite and trap rock sand at the Sewaren, New Jersey, generating station of the Public Service Electric and Gas Company. Where abrasion, heat and corrosion are problems, it pays to use Lumnite from the start.



SMOOTH—Gunite made with Lumnite and trap rock sand forms a smooth jointless lining that resists heat in this hot-air duct at the Sewaren generating station.

DURABLE—Gunite made with Lumnite and trap rock sand resists corrosion in this water-filled ash hopper also at the Sewaren generating station. For other jobs, Lumnite with suitable aggregates will resist thermal shock and 2600°F. heat.

WHETHER YOU NEED a *tough*, *heat-resistant* concrete for flues, ducts, stacks, breechings or ash pits . . . a *corrosion-* and *wear-resistant* bunker lining . . . or a fast, *overnight* foundation—you'll find adaptable Lumnite fills the bill.

Concrete made with Lumnite calcium-aluminate cement is highly resistant to the corrosive attack of sulphurous gases and the abrasive action of high velocity gases and fly ash. Low volume change enables it to withstand high temperatures and severe thermal shock. It reaches service strength in 24 hours or less, so construction or repairs go *fast*.

FOR CONVENIENCE—use castable refractory mixes of Lumnite and selected aggregates to meet specific temperature and insulation requirements. Made by manufacturers of refractories and sold by their dealers. For more information write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

FAST—Placed in 15° below zero weather, Lumnite Concrete power-line tunnel gained full service strength in 24 hours. In service over 27 years at International Harvester, Chicago. Use this durable *overnight* concrete and cut costly outage!

*"*LUMNITE" *is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-70-R

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supplements other advertising in this issue with these additional announcements of products and services essential to modern plant management and Maintenance. Make a habit of checking this page, each issue.
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POWER

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*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

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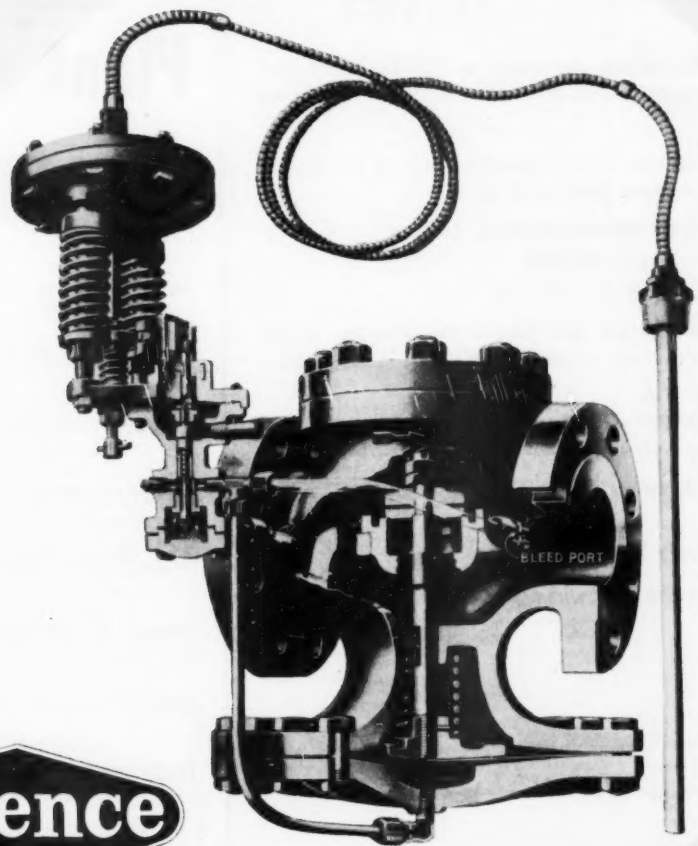

SPENCE
TYPE ET150
Temperature
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SPENCE ENGINEERING COMPANY, INC.
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New Ads: Address 330 W. 42nd St., New York 36, N. Y. for July issue closing June 10th.

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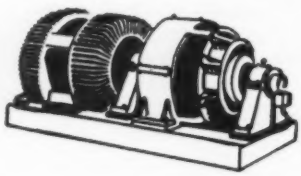

This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised (this service is for user-buyers only).

Just send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

Searchlight Equipment Spotting Service
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330 W. 42nd St., N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE • NO OBLIGATION

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6/53

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Graduate mechanical engineer experienced in public utility steam plant operations required by progressive public utility company in Central America as Supervisor of 7,000 KW Steam Station. Must be qualified to handle men, operating and maintenance problems. A good working knowledge of Spanish a requisite. Preferred age range 30-45. Attractive salary. Good living and working conditions. Splendid opportunities for right man. Write giving age and fullest details of qualifications and experience.

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Highest Prices Paid. Send us your lists.
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PORTABLE BOILER
One 250-hp 125-psi portable boiler.
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SELLING OPPORTUNITY OFFERED

SALES ENGINEERS, with experience in the sale of mechanical equipment, wanted for positions involving general application and sale of heating, ventilating, and air handling apparatus for commercial and industrial buildings, industrial processes, and mechanical draft. Positions are available in the Southeast and Great Lakes regions. Personal interviews will be granted only after receipt of written application giving full details of experience. Address: Sturtevant Division, Westinghouse Electric Corporation, Dept. AH, Hyde Park 36, Boston, Mass.

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SALARIED PERSONNEL. $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

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WATCH ENGINEER—Age 35. 14 years marine and stationary high pressure power plant experience. Includes boilers, turbines, switchboard, and auxiliaries in utility and industrial fields. Presently employed in foreign service. Desire position in Southwest U.S. or California. Available for interview during August and September. PW-7950, Power.

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MECHANICAL
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Excellent working conditions, paid vacations, hospital insurance, pension plan and other employee benefits. Good opportunity for advancement in an expanding and progressive utility.

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Young engineers capable of mechanical estimating for construction of refineries, steam power and similar industrial projects. Must have some field experience.

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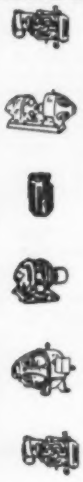

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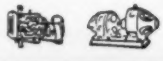

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We own and offer, in original crates, the following G.E. NEW steel mill equipment:

2—350 HP, 375-750 RPM, 230 v., MDP-422 mill motor w/blower and fan

1—250 HP, 410/820 RPM, 230 v., MDP-420 motor w/blower & fan

3-unit synchronous motor generator set —suitable for 60 cycle

1—1250 KW, 750 RPM, 600 v., shunt wound DC gen. 40°C rise

1—750 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—3000 HP, 750 RPM, 6000 v., 3 ph., 50 cy., .8 PF, 40°C rise

3-unit synchronous motor generator set —suitable for 60 cycle

1—400 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—750 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—1750 HP, 750 RPM, 6000 v., 3 ph., 50 cy., .8 PF, 40°C rise

Control equipment for the above is available. Your inspection is invited.

WE OFFER THESE AT SPECIAL BARGAIN PRICES

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BOILERS—Water Tube, Stirling & Straight Tube types 200 to 450#.

Special 2—500 & 1-770 H.P. B&W Co. Stirling Boilers 200#—excellent condition.

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TRANSFORMERS Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators, Rotaries, Frequency Changers, Large Motors & Diesel Generators.

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Stepless speed variation with constant speed prime mover made by American Blower Co.
Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers & rotary kilns.
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Complete engineering data & quotation on request.
Large selection of marine couplings, reduction gears, & Falk grid type couplings in stock.

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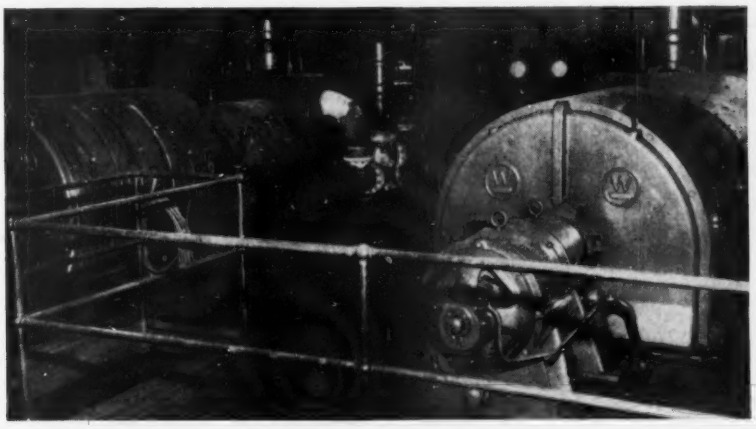
Same as New. Modern. Non-condensing.

2500 KVA TURBO-GENERATOR

With Changes—A 400# PSIG., 700°F. TT., 50# BP., Turbine.
Very Complete INSPECTION REPORT in our files. Yours on Request.
Our Own Property. *Can Deliver IMMEDIATELY.*



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WATER RATE:	KW. Load	1000	1500	2000	2500
	Lbs. KWHr.	27.1	25.85	26.0	26.2

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TURBO-GENERATORS ALL 3600-RPM.

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3	625-KW.	G.-E.	160/200 psig. 480-V
4	750-KW.	A.-C.	150/200 psig. 480-V
5	750-KW.	West.	140/200 psig. 2300-V
6	750-KW.	A.-C.	150/200 psig. 2300-V
7	750-KW.	G.-E.	150/200 psig. 480-V
8	1000-KW.	G.-E.	175/250 psig. 2300-V
9	1000-KW.	A.-C.	125/200 psig. 2300-V
10	1500-KW.	A.-C.	150/200 psig. 2300-V
11	1200-KW.	G.-E.	175/200 psig. 2300-V
12	2000-KW.	G.-E.	150/200 psig. 2300-V
13	2500-KW.	G.-E.	150/250 psig. 2300-V
14	3000-KW.	G.-E.	150/250 psig. 480-V
15	4000-KW.	West., A. Ext.	275/400# 600-V
16	5000-KW.	G.-E.	150/200# 2300-V
17	5000-KW.	West.	250/400# 480-V.

NON-CONDENSING

No.				
1	500-KW.	A.-C.	125#:10/15 BP.	480-V
2	500-KW.	G.-E.	175#10/15 BP.	480-V
3	500-KW.	West.	250/400:125# BP.	2300-V
4	750-KW.	G.-E.	125#:10# BP.	480-V
5	1000-KW.	G.-E.	125#:15 BP.	480-V
6	1250-KW.	G.-E.	200/250 psig. 20# BP.	480-V
7	2000-KW.	West.	250/350#:35# BP.	2300-V
8	2500-KW.	G.-E.	150/175#:15# BP.	2300-V
9	3000-KW	A.-C.	425#750F:60# BP.	13200-V
10	4000-KW	G.-E.	425#, 75° FSH. 60# BP.	13200-V

BOILERS, ETC.

B&W., 600#, 100,000# Steam per hr.
2—Springfield 511-HP., 250# 1935
1—Springfield 900-HP., 400# 1932
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7 x 7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Meter—580 H. P. Synchroneus 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. D.C. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

55" LIFTING MAGNETS

2—55" Cutler Hammer Magnets 250 Volts DC. Excellent Condition.

1—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

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60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP G. E. Type KT 3/60/440/600 RPM.

250 HP G. E. Type KT 3/60/440/720 RPM.

T.E.F.C. MOTORS

2—200 HP West. XP-3/60/2200/3600, Frame 8120H.

1—125 HP G.E., TEFCBB, Frame KF63282, 60/3/440/3600 RPM.

60 HP West. CS-607 3/60/440/900, X-Proof.

50 HP Ideal, New, 3/60/220/440/1800.

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15 HP Louis Allis Ex-364, 3/60/220/440/1800, X-Proof.

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

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4—333 KVA Gen. Elect. Transformers Type H Form VRW Primary 2400/4800 Secondary 240/480 Single Phase 60 cycle with Taps. Immediate Shipment.

3—200 KVA Niagara—New. OISC. 1 Ph. 60 Cy. 2400/4160Y. 240/480.

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6—50 KVA. Niagara—New. Dry Type 1/60/-240/480—120/240.

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70 CFM	Smith (Gas) 2 PNEU	
105 CFM	Worthington & Ingersoll	
190 CFM	Worthington (Gas) 2 & 4 PNEU	
210 CFM	Worthington (Gas & Diesel)	
315 CFM	IR & Worthington (Gas & Diesel)	
500 CFM	Worthington (Diesel) 4 PNEU	
600 CFM	Worthington (Diesel) 4 PNEU	

STATIONARY

CFM	PSI	SIZE	MANUFACTURER
44	150	5x5	Ingersoll ER-1
66	110	6x5	Penn-IR
69	125	6x6	Ingersoll ER-1
88	60	7x5	IR-Penn
93	100	7x6	American-IR
122	100	7x7	Worthington-IR
136	125	8x8	American-IR
186	135	8x9	IR-Worthington
211	100	9x9	Worthington HB
254	125	10x10	Chicago Pneu.
298	125	10½x11	American AF-1
311	40	12x8	CPT-Penn-IR
364	20	12x7	Worthington-IR
368	100	12x10	IR-CPT
379	40	12x9	Worthington HB
386	115	12x12	Ingersoll ER-1
460	125	12x13	American
583	60	14x10	IR-Sullivan
628	100	14x12	CPT-IR
628	100	14x15	Ingersoll
748	40	17x10	CPT-IR
780	55	17x12	Ingersoll ER-1
868	125	17/10x12	Chicago Pneu.
951	55	17x13	Worthington
1064	30	20x12	IR-CPT
1150	125	18/11x16	Chicago
1282	35	20x13	Worthington
1967	12	28x15	Worthington

America's No. 1 COMPRESSOR REBUILDER *Since 1902*

We have a unit for your requirements from our stock of over 300 compressors & vacuum pumps.

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St., North Bergen, N.J. · Union 5-4848

TRANSFORMERS FOR SALE

6—	1000 KVA Mol.	11500—2400/4160Y
3—	500 KVA G-E	22000—2300/4000Y
2—	333 KVA G-E	13800—230/460
3—	333 KVA W-H	6600—2300
3—	200 KVA G-E	22000—2300
3—	200 KVA Mol	3450—2300
3—	150 KVA G-E	44000—600/2400
3—	150 KVA G-E	19050/33000Y—2540/4000Y
2—	150 KVA G-E	6900—230/460
3—	100 KVA G-E	33000—6900/11950Y
3—	100 KVA G-E	13200—2300
3—	50 KVA A-Ch	33000—6900/11950Y
3—	50 KVA A-Ch	33000—2400/4160Y
3—	50 KVA A-Ch	13200—2300/4600
1—	500 KVA W-H	27600—444/131 3-phase Rotary

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
CINCINNATI 27, OHIO
40 Years Dependable Service

FOR SALE

Power plant equipment, Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINE COMPANY
Jackson, Miss.

CHICAGO Electric Digest

PUBLISHED BY CHICAGO ELECTRIC CO. • THE HOME OF GUARANTEED REBUILT POWER EQUIPMENT

EQUIPMENT REBUILDING AT ITS FINEST!

M. G. SETS

KW	Make	AC	DC
2400	A. C.(3-unit)	4800	525
2400	Westgh. "	4800	600
1000	G. E. "	11000	137½/275
1000	Westgh. "	11000	137½/275
500	A. C.-West.	2300	250
500	Cr-Wh.	220/440	250
450	G. E. (3-unit)	2300	125/250
400	A. C.	2300	120/240
250	West.-G. E.	440	250
200	Ridgeway	2200	250
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	Delco-G. E.	440	120/240
90	G. E.	440	60
75	A. C.	440	250
60	A. C.	2300	110
60	G. E.	440	250
40	Cr-Wh.	220	125
40	A. C.	220	125
40	G. E.	220	125
35	G. E.	440	125
25	Westgh.	2200	125
25	G. E.	220	275
20	G. E.	440	250
20	Bogne-GE	440/550	250
20	Bogne-GE	220/440	250
20	Bogue-GE	220/440	125
	DC to AC		
100	G. E.	230	235
75	Westgh.	2200	110
12½	Westgh.	240	115

WE WILL BUY

YOUR SURPLUS MOTORS
GENERATORS • M.G. SETS
HOISTS • COMPRESSORS
TRANSFORMERS

CASH or TRADE

Write full details for our
OFFER BY RETURN MAIL

AIR COMPRESSORS

Size	Make	Type	Psi.	Disp.
12x11	Worth.	HB	100	426
10x11	Worth.	HB	100	294
9x9	Worth.	HB	100	211
8½x9	Worth.	HB	100	170
7x7	Worth.	HB	100	122
	Worth.	M-50	80-125	284
	Worth.	M-25	80-125	142
7½ HP	Worth.	AT833	100	35
10 HP	Worth.	AU933	100	48.8
5 HP	Worth.	3-TT	100	25.3
3 HP	Worth.	AS-8	100	17
2 HP	Worth.	2-TT	100	10.7
2½x2½	Quincy		150	5

AC SYNCHRONOUS

GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volt (*2200 volts or higher)

KVA	Make	Type	P.F.	Spd.
3500	*G. E.		.8	720
1750	*Westgh.		.7	900
1500	G. E.	ATI	.8	720
312	G. E.	ATI	.8	900
300	*G. E.	ATI	.8	720
225	G. E.	ATB	.8	600
187	Westgh.	ES	.8	720
112½	*G. E.	ATB	.8	1200
110	Cr-Wh.	103	.8	900
100	*G. E.	ATB	.8	900
60	Fbks-M.	B	.8	900
55	G. E.	ATB	.8	1200
50	G. E.	ATB	.8	1200
50	Westgh.		.8	1200
50	G. E.	ATB	.8	900

SQUIRREL CAGE

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*220 volts or higher)

HP	Make	Type	Speed
1750	*G. E	K	3600
1000	*G. E	K63478	1800
750	*A. C	TEFC	1800
750	*G. E.	KT	720
700	G. E.	FT	3600
500	*G. E.	PBG	3600
500	*A. C.	63168W	1800
450	*G. E.	KF567S	1200
400	*Westgh.	CS	1800
400	*G. E.	KTP562	1800
400	A. C.	ANW	900
400	*G. E.	IK	514
350	*Cr-Wh BBDP	SC	3600
300	*Westgh.	CS	3600
250	*L. Allis	OGS	1800
250	*L. Allis	OGX148S	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	*G. E.	IK13B	1800
200	A. C	ARWWT	600
200	G. E.	IK-17	600
150	*A. C.	AN	1800
150	G. E.	IE-K	1800
150	*G. E.	IK	600
150	A. C.	AR	325
125	Westgh	CS504S	3600
125	*A. C.	AR226	1800
125	G. E.	IK	1200
100	*G. E	FT542Z	1800
100	Westgh.	CS	1800
100	A. C.	AW	1200
100	G. E.	IK13A	1200
100	U. S.	CFU(Vcrt)	1200
100	*Westgh	CS(Vert)	1200
100	A. C	AN	900
100	G. E.	IK15A	514
75	Westgh.	CS445S	3600
75	A. C.	AN	1800
75	Westgh	CS645C	1800
75	G. E.	KT346	1200
75	G. E.	IK	1200
75	Westgh.	CS	900
75	*A. C	AR(Vert)	900
75	A. C.	AN	720
75	G. E.	IK	600
75	*Triumph	TR16	514
75	G. E.	IK	514
60	*Westgh.	CS504S	1800
60	A. C.	APZ445S	1800
60	A. C	APZ504U	1200
60	G. E.	KT343	1200
60	A. C	AR823	900
60	A. C.	AR826F	514

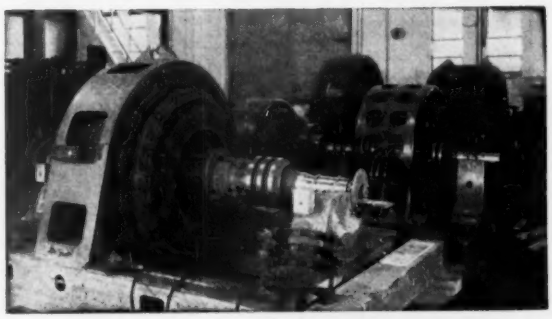
Hundreds of smaller motors!

AC SYNCHRONOUS

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	P.F.	Spd
2500	*A. C.		1.0	514
1420	*Westgh.		.7	900
720	*G. E.(25 cy)	ATI	1.0	750
700	*G. E.	TS975Z	1.0	1200
600	*G. E.	TS7640	1.0	900
600	*G. E.	ATI	1.0	240
400	Westgh.	HG	1.0	900
300	G. E.	ATI	.8	900
300	*G. E.	ATI	1.0	720
300	Ideal	SNS	1.0	257
190	Elc-Mch	2S	1.0	720
175	*Westgh.	HR	1.0	360
150	*Westgh.	HR	.8	900
125	G. E.	ATI	1.0	900
125	*Elc-Mch		1.0	900
125	Cr-Wh.	103S	1.0	900
125	*G. E.	TS	1.0	277
115	Elc-Mch	EM	1.0	240
100	Cr-Wh.	103S	.8	900
100	*G. E.	ATB	.8	900
100	Westgh.		1.0	900
100	Ideal	SNS	1.0	900
100	G. E.	TS6184	1.0	450
40	G. E.	ATB	.8	1200
20	Fynn-W	15VRN		1200
15	Ideal			1800
15	Century	ARC365	1.0	1200
7½	Ideal			1800



SLIP RING

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

2000	*G. E.	MT-12	600
1500	*G. E.	MT30	240
1250	*Westgh	CW	600
1000	*Westgh	CS	250
700	*A. C.		720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	G. E	IM	720
500	Westgh.	CW	350
400	A. C	3-brg	450
400	*G. E.	MT412	450
300	*G. E.	IM15A	1800
300	*G. E.	MT410	450
250	Westgh.	HF15H	600
200	G. E	IM	1800
200	G. E.	IM15	1200
200	Westgh.	CW	600
150	Westgh.	CW772C	1200
150	*G. E.	IM16	600
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM15A	450
75	Nwstrn.	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	Westgh.	CW762C	900
50	G. E	IM11A	1800
50	*A. C.	ARY	1800
50	Westgh.	CW636A	1200
50	G. E	MT346	720
50	G. E.	IM14	450
40	*G. E.	MT532	1200
40	G. E.	MT336	1200
40	Westgh.	CW644	900
40	G. E	M504U	900
35	Fbks-M.	UAB(Vert)	1800
35	G. E.	IM	1200

TRANSFORMERS

KVA	Make	Phase	Pri.	Sec.
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
667	G. E.	1	33000	480
333	A. C.	1	14400	240/480
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
200	Wagner	1	2400	575
167	A. C.	1	2400	120/240
100	Pittsbgh.	1	2400	575
100	A. C.	1	2400	120/240

CHICAGO ELECTRIC does a thorough rebuilding job. Another example of this is shown in the photo at the left . . . a 1000 H.P. Slip Ring Mill Motor. The illustration shows the motor stripped down preparatory to rewinding. Skill, quality materials and pride of workmanship go into every Chicago Electric job. . . . Equipment rebuilding at its finest.

In addition to this outstanding rebuilding and repair service, Chicago Electric maintains one of the nation's largest stocks of guaranteed rebuilt power equipment. Whatever you need in the line of AC & DC MOTORS, M. G. SETS, GENERATORS, CONVERTERS, COMPRESSORS, HOISTS and other allied equipment you'll be sure to find it at CHICAGO ELECTRIC.

D. C. MOTORS

Mill Type—Pedestal Bearing Reversing

HP	Make	Volts	Speed
3000	Westgh(Tandem)	525	600
1750	Westgh	600	550
1500	Westgh	525	600
1200	Westgh	525	600
1000	Westgh	450	600

Mill Type—Non-reversing

HP	Make	Type	Speed
1500	Westgh (600v)		200/400
700	Westgh (600v)	MCF	150/525

230 Volts—Constant Speed

175	G. E.	ELC	750
125	G. E.	Marine	1200
100	G. E.	RC34	2500
100	G. E.	RC19	575
75	G. E.	MD8106	485
60	G. E.	CD-115	860
50	G. E.	RC35	700
40	Cr-Wh.	CMC	1750
50	G. E.	CO2004	600
35	Cr-Wh.	CM351	700
30	G. E.	MD104½	725
30	Cr-Wh.	CCM	440
25	G. E.	CD93	1200
25	G. E.	RC32	800
25	Westgh.	SK100L	1100
25	Westgh.	SK133	575

Many others—1 HP and up
Also Variable-Speed and 115 Volts

Phone: CAnal 6-2900

CHICAGO Electric Co

1320 West Cermak Road, Chicago 8, Ill.

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	6000	G.E.	100	2300	90
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
2	1750	G.E.	100	2300	3600
1	750	G.E.	80	2300	450
1	600	G.E.	100	440	360
1	700	G.E.	80	2300	720
1	250	G.E.	100	2300	514
1	200	Whse.	80	440	1200
1	187	G.E.	80	440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550	600
1	150	Whse.	80	220/440	450
2	135	G.E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440	1800
1	100	Ideal	80	440	900
2	100	G.E.	80	440	600

With these we can supply—Manual, Semi on full magnetic reduced or full voltage control.

SQUIRREL CAGE MOTORS

3-Phase — 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806	2300	1200
2	400	G.E.	I-K	2200	v514
1	400	G.E.	KT-412	2200	450
1	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-873-C	2200	1200
1	200	Al.Ch.	ARY	440	600
1	125	Al.Ch.	AR	2200	1750
1	125	Al.Ch.	AR	2300	514
1	125	C.W.	126-Q	440	430
2	100	Whse.	CS-663-C	440	1750
1	100	Al.Ch.	AR	550	720
1	100	Whse.	CS-938	2200	514
1	100	F.M.	H-241	440	450
2	75	Al.Ch.	AR	2200	1705
1	75	G.E.	I-K	440	600
1	75	Al.Ch.	AR	2200	720

Special—1 (new) G.E. Vertical KF-574, 2200-Volt 580 R.P.M., enclosed, hollow shaft

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1 (3-U)	2400	Whse.	720	600	4800/2400
1	1500	G. E.	600	600	4160/2300
3	1000	Whse.	514	600	11,000/6600
2	1000	G. E.	514	600	11,000/6600
1	750	Whse.	900	250	4160/2300
2	500	C. W.	720	575	2300/440
1 (3-U)	500	Whse.	1200	125/250	440
1	400	C. W.	1200	125/250	440
2	250	Whse.	1200	125/250	2300/440
1	200	Whse.	1200	275	4000/2300
1	200	Whse.	1200	125/250	4000/2300
1	155	G. E.	720	250	2300/440
2	150	Whse.	1200	125/250	440
1	100	Delco	1200	125/250	440/220
1	100	Ridgeway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	85	C. W.	1200	250	440/220
1	75	Al. Ch.	900	250	2300
1	75	Whse.	900	240	2300
1	25	Ideal	1750	125	440/220
1	25	Al. Ch.	1200	250	440/220
3	20	Al. Ch.	1200	250	440/220
2	15	Al. Ch.	1200	250	440/220

We can furnish any of these sets with D. C. panels, A.C. starting equipment, exciter sets and other accessories.

Motor Generator Sets of modern design, complete with control—still on their original foundations—available for immediate shipment.
(3)—G. E. 1500-KW, 250-VDC, 514 R.P.M., cpd., interpole, pole face windings, 2100-HP sync. motors, 3-PF, (3,200-V, 3-p, 60-cy. will re-connect to 6600-V. or 4160-V.

TRANSFORMERS (Power)

Outdoor—Oil Cooled

Qu.	KVA	Make	Type	Phase	Voltage
3	250	Packard	A	1	13200-2200
3	150	Packard	A	1	2300-230/460

3—833-KVA Westinghouse O.I.S.C. transformers, type S, one phase, 60 cycle, still on original foundation, primary 66,000 Volts with (4) 2½% taps below secondary 2300/4160-Y. Can ship immediately from location.

SLIP RING MOTORS—CONSTANT DUTY

3-Phase — 60 cycle

Qu.	H.P.	Make	Type	Volts	R.P.M
1	1800	G.E.	MT 498	2300	357
1	1200	G.E.	MT 28	2200	277
2	1000	Al.Ch.	ANY	2200	235
1	800	G.E.	MT	2200	440
1	600	G.E	MT 20	2300	360
1	500	Al.Ch.	ANY	2200	514
2	500	G.E.	I-16-M	2300	450
1	400	G.E.	MT 412	2200	440
1	250	Whse.	CW 937	440	1200
1	250	Al.Ch.	ANY	440	720
1	250	G.E.	MT 414	2200	300
1	125	Whse.	CW 870	2200	900
1	100	Whse.	CW 766	440	1200
1	100	F.M.	H 20 C	440	900
2	100	G.E.	I-15A-M	2300	514

DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	R.P.M.
1***	3000	Whse.	Encl. (Rev.)	600
1***	2400	Whse.	Encl. (Rev.)	600
4***	1500	Whse.	Encl. (Rev.)	600
4***	1200	Whse.	Encl. (Rev.)	600
4***	800	Whse.	Encl. (Rev.)	600
10**	700	Whse.	Mill	285/720
1	350	G. E.	CD-169	1150
1**	250	G. E.	MPC-6	325/975
1**	200/250	El. Dy.	Size 22	400/1200
1**	200	Whse.	Mill	300/1200
1**	200/250	G. E.	MPC	300/900
1**	180	G. E.	MPC	100
1***	125	Whse.	SK-190	600
1**	90/160	G. E.	MPC	625/1125
2	125	Whse.	SK-184	575/850
1	75	G. E.	CD-133	500/1000
1	60	El. Dy.	25-S	450/900
1	50	G. E.	RF-16	300/900
1	50	Whse.	SK	250/1000

All above are 230-VDC except where marked ***
***—Pedestal bearing mill type 525/600-VDC
**—Pedestal Bearing 230-VDC

T. B. MAC CABE COMPANY

4314 CLARISSA STREET · Phone DAvenport 4-8300 · PHILADELPHIA 40, PENNA.

NEW MOTORS! ★ STOCK SHIPMENT

ALL BALLBEARING

General Electric, Louis Allis, Reliance, Westinghouse.
NEMA FRAME

Discounts from 60% to 65% Off on items listed below.

TEFC & EXPLOSION-PROOF
3/60/220-440

Quan.	HP	Speed	Make	Frame
1	75	3600	G.E.	504
2	60**	3600	Rel.	445
2	60**	3600	G.E.	445
1	60	3600	Wag.	445
1	50**	3600	G.E.	444
2	40**	3600	Rel.	405
1	40**	3600	G.E.	405
1	30*	3600	L.A.	405
2	30**	3600	G.E.	404
5	20**	3600	L.A.	364
1	15*	1800	L.A.	326
1	15*	1800	L.A.	364
1	10*	3600	L.A.	284
5	10**	3600	L.A.	284
2	10*	1800	L.A.	324
5	5**	3600	L.A.	225
3	5*	1800	L.A.	254
1	5*	900	L.A.	324
1	2*	1800	L.A.	225
1	2*	1800	L.A.	224
1	2*	1800	L.A.	225
1	1½*	1200	L.A.	224
10	1*	3600	L.A.	167
1	½*	1800	G.E.	63A

1/60/115-230

6	3*	1800	L.A.	254
1	1½*	1800	L.A.	225
6	1*	1800	L.A.	224

* 1-D Label—** 2-G Label

OPEN DRIP-PROOF—3/60/220-440

Quan.	HP	Speed	Make	Frame
1	100	3600	G.E.	445S
13	40	3600	Rel.	404S
1	30	3600	G.E.	365
1	25	3600	G.E.	364S
2	15	3600	L.A.	324
1	10	3600	L.A.	284
1	10	1800	L.A.	324
1	7½	1800	L.A.	284
1	7½	1800	L.A.	284
7	7½	900	L.A.	326
1	5	3600	L.A.	254
1	5	1800	L.A.	254
2	5	1200	L.A.	284
2	5	900	L.A.	324
7	3	1800	Std.D.	225
4	3	1800	L.A.	225
2	3	1200	L.A.	254
2	2	1800	L.A.	224
10	2	1200	L.A.	225
1	1½	1800	L.A.	204
2	1½	1200	G.E.	224
2	1½	1200	L.A.	224
7	1	3600	Rel.	203
2	1	1200	L.A.	204

3/60/220 GEARMOTORS

3—5/3.3/2.3/1.66 HP, 55/36/27/18 RPM, Whse. Frame FD324, Parallel shaft output.
35 ½ 13.5 G.E. 63A
Parallell shaft—220/440 V

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(6) OIL FIRED B&W BOILERS

Cross Drum Sinuous Headed straight tube type. Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

(4) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed .440/60/3 AC generator set.

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100 KW General Motors Model 3-268A, A.C. & D.C. units. Rebuilt.
50 KW Int'l Harvester set, 4 Cyl., 3/60/120/208 V. Rebuilt.
Other sizes in stock, AC & DC Units.
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STerling 3-6515

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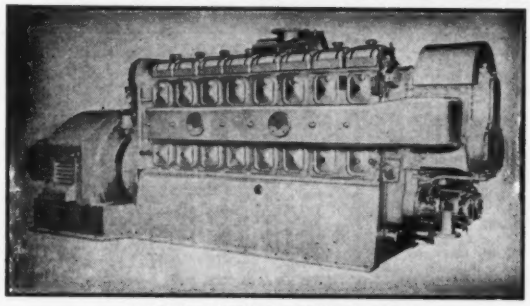
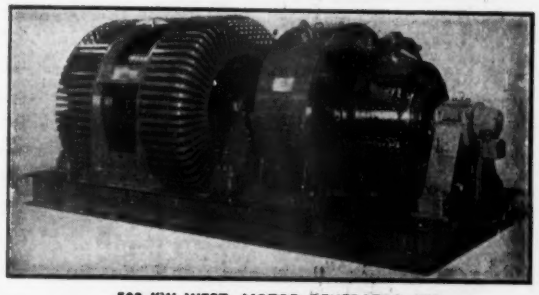
Read More About "The O'Brien Story," in the next Issue of Power.



375 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1500 KW G.E. 250 Volt 3/60/2300/360 RPM
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #813047 (year 1935) See actual photo above.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
200 KW Elliott 250 Volt 1200 RPM 3/60/ Any Voltage.
2—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.
Smaller Sizes and Types—Advise Requirements

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single phase 60 cyc.

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	1000	GE	13200	2300	1
1	1000	Penna.	13200	480	1
1	1100	West.	4160	440	3
3	750	West.	2300	230	1
3	500	GE	13200	2300	1
3	333	(New)	2400	480	1
3	333	GE	13200	2300	1
3	250	West.	13200	2300	1
3	200	GE	7200	120/240	1

OISC TRANSFORMERS (Con't)

3	200	GE	13200	2300	1
3	200	Mal.	2300	220/440	1
3	200	GE	13200	2300	1
3	200	GE	7200	2300	1
3	150	GE	33000	220/440	1
3	150	Niag.	2400	240/480	1
3	100	West.	11000	480	1
3	100	GE	7200	120/240	1
2	100	GE	2300	115/230	1
3	75	Mal.	2300	115/230	1

DIESEL & GASOLINE GENERATOR SETS

1—1250 KVA Nordberg 3/60/2300/360 RPM 1940
6—875 KVA G.E.—Busch Sultzer 3/60/2300/275 RPM, Complete Plant, 1940
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 KVA Hercules. 3/60/220/440/1500 Hrs.
1—56 KVA Climax Gasoline, 3/60/220/1200.
2—45 KVA Chry. New 6 Cyl. 3/60/220/440.
1—200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	600	West.	CS	2200	600
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
2	400	G.E.	IK	2300	1800
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	250	G.E.	IM	2300	450
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600

EXCEPTIONAL DELIVERY
New O'Brien mfrd. Red Line dry type Transformers to 150 KVA single phase, 300 KVA, 3 phase—4800 V. Pri—& Phase Changers to 100 KVA.

ELECTRIC MOTORS (Con't)

2	100	G.E.	KT352	220/440	1200
2	100	G.E.	Syn.	440	300
1	100	G.E.	KT543	440	1800
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

TURBO GENERATORS

1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 30 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
1—200 KVA Moore Non-Condensing 3/60/480, 195 PSI, 100° F, 100# BP. Year 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

PLATING, ANODIZING SET

1250 amps 15 V. 900 rpm Columbia 30 HP Sq. Cage Motor 3/60/220 Direct Drive Complete on base with DC Panel.

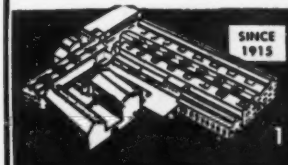
AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 930 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—868 CFM Sullivan 17x10x12, 100 psi.
1—628 CFM Ing. Rand 14x12, 100 psi.
1—215 CFM Penna 3A, 70 psi—V-Belt
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7½x5x4, 100 psi

BOILERS

4—500 HP Cleaver Brooks Package 200 lb.
1—300 HP Cleaver Brooks Package 160 lb.
1—450 HP Keeler CP 160 lb. Oil
1—300 HP Keeler CP 300 lb. Oil
1—150 HP Union Univ. Stoker 150 lb.
1— 60 HP Ames Package 125 lb.

"Everything from a Pulley to a Powerhouse"



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POWER PLANT MACHINERY

TURBINE GENERATOR UNITS
3 Phase 60 Cycle

32,500 KVA G.E. Cond. 250 lbs. 12000/13200 volts.
12,500 KVA West. Cond. 200 lbs. 2400 volts.
5,000 KVA G.E. Non-cond. Extraction 600 lbs.-125 lbs. extr. 50 lbs. exh. 13,800 volts.
5,000 KVA West. Cond. Extraction 400 lbs.-125 lbs. extr. 2400 volts.
3,750 KVA West. Cond. Extraction 175 lbs.-25 lbs. extr. 240 Ovolts.
3,125 KVA West. Cond. 400 lbs. 2400/4160 volts.
2,500 KVA West. Cond. 200/400 lbs. 2400 volts.
1,875 KVA G.E. Cond. 225 lbs. 480 volts.
1,563 KVA G.E. Cond. 150 lbs.-15 lbs. extr. 480 volts.
1,250 KVA West. Non-cond. 150 lbs.-30 lbs. exh. 480 volts.
1,250 KVA West. Cond. Extraction 250 lbs.-125 lbs. extr. 480 volts.
1,175 KVA A.C. Cond. Extraction 300 lbs.-30 lbs. extr. 240 volts.
938 KVA G.E. Non-cond. 150 lbs.-20 lbs. exh. 480 volts.
938 KVA West.-Terry Cond. Extraction 250 lbs.-45 lbs. extr. 480 volts.
625 KVA G.E. Non-cond. 175 lbs.-30 lbs. exh. 2300 volts.
187 KVA West. Non-cond. 150 lbs.-15 lbs. exh. 480 volts.

UNIFLOW GENERATOR UNITS
3 Phase 60 Cycle

750 KVA Ames vertical, 150-175 lbs. 240/480/2300/4160 volts.
500 KVA Skinner horizontal, 150 lbs. 240 volts.
375 KVA (2) Skinner horizontal, 150 lbs. 240/480 volts.
312 KVA Skinner horizontal, 150 lbs. 240 volts.
250 KVA Ames vertical, 150 lbs. 480 volts.
210 KVA Skinner horizontal, 150 lbs. 240 volts.
156 KVA Skinner horizontal, 150 lbs. 240 volts.

DIESEL GENERATOR UNITS
3 Phase 60 Cycle

1,250 KVA Nordberg, 2400 volts 257 RPM.
1,000 KVA DeLaVergne, 2400 volts 200 RPM.
856 KVA DeLaVergne, 2400 volts 240 RPM.
650 KVA Superior, 2400 volts 327 RPM.
625 KVA Cooper-Bessemer, 480 volts 600 RPM.
600 KVA Fairbanks Morse, 2400 volts, 300 RPM.
500 KVA (2) Fairbanks Morse, 2400 volts 400 RPM.
450 KVA Fairbanks Morse, 2400 volts, 300 RPM.
450 KVA (3) Alco, 480 volts 514 RPM.
425 KVA Fairbanks Morse, 2400 volts, 400 RPM.
412 KVA Fairbanks Morse, 2400 volts, 514 RPM.
400 KVA (3) General Motors, 480 volts 1200 RPM.
375 KVA (3) Worthington, 2400 volts, 327 RPM.
300 KVA Fairbanks Morse, 2400 volts, 300 RPM.
250 KVA Worthington, 240 volts, 327 RPM.
175 KVA Fairbanks Morse, 2400 volts, 300 RPM.
150 KVA Fairbanks Morse, 240 volts, 360 RPM.
150 KVA Worthington, 240 volts, 600 RPM.
135 KVA Fairbanks Morse, 2400 volts, 3600 RPM.
125 KVA Hercules, 440/220/127 volts, 1800 RPM.
112 KVA (2) Cooper-Bessemer, 2400 volts, 450 RPM.
90 KVA Fairbanks Morse, 2400 volts 300 RPM.
75 KVA Winton (gasoline) 240/480/2400 volts 1200 RPM.
62½ KVA International Harvester, 240 volts, 1200 RPM.
37½ KVA General Motors, 240 volts, 1200 RPM.

STEAM BOILERS

150,000 lbs. per hr. (3) B.&W., 250 lbs. stoker coal
100,000 lbs. per hr. B.&W., 450 lbs., stoker coal
50,000 lbs. per hr. B.&W., 450 lbs. pulv. coal.
35,000 lbs. per hr. (2) B.&W., 400 lbs., coal or gas.
22,500 lbs. per hr. Keeler, 300 lbs., stoker coal.
20,000 lbs. per hr. B.&W., 125 lbs., stoker coal.

MOTOR GENERATOR SETS
3 Phase 60 Cycle

3,000 KW G.E. 13200 volts AC—250 volts DC.
2,000 KW G.E. 13200 volts AC—250 volts DC.
2,000 KW A.C. 2300 volts AC—250 volts DC.
1,500 KW G.E. 2300/4000 volts AC—250 volts DC.
500 KW (2) West. 2300/4160 volts AC—250 volts DC.
300 KW G.E. 2300 volts AC—250 volts DC.
200 KW (3) West. 2300/4000 volts AC—250 volts DC.
100 KW West. 2300 volts AC—250 volts DC.

ROTARY CONVERTERS
3 Phase 60 Cycle

3,250 KW G.E. 13800 volts AC—250 volts DC.
1,500 KW (2) West. 13200 volts AC—250 volts DC.
300 KW A.C. 13200 volts AC—250 volts DC.
150 KW (3) West. 6600 volts AC—250 volts DC.

TRANSFORMERS
60 Cycle

10,000 KVA (1) A.C. 3 ph., 12000-2400/4160 volts.
6,300 KVA (1) West. 3 ph., 66000-6600 volts.
6,000 KVA (1) Pgh. 3 ph., 11000-2300 volts.
5,000 KVA (1) A.C. 3 ph., 12000-2400/4160 volts.
3,000 KVA (1) Stand. 3 ph., 33000-4160 volts.
2,125 KVA (3) G.E. 1 ph., 13200-2300/4000 volts.
2,000 KVA (5) West. 1 ph., 38000-12000 volts.
800 KVA (3) Wgnr. 3 ph., 2400/4160-480 volts.
500 KVA (3) Pakd. 1 ph., 13200-1100/220 volts.
500 KVA (4) G.E. 1 ph., 33000-7200/12470 volts.
500 KVA (1) G.E. 3 ph., 2200-600 volts.
333 KVA (3) G.E. 1 ph., 33000-2300 volts.
300 KVA (2) G.E. 3 ph., 69000-2300/4160 volts.
250 KVA (3) G.E. 1 ph., 2300-150/230 volts.
200 KVA (3) Nga. (New) 1 ph., 2400/4160-240/480 volts.
150 KVA (3) G.E. 1 ph., 33000-7200/12470 volts.
100 KVA (9) G.E. 1 ph., 33000-7200/12470 volts.

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UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS
1—20,000 KW, 280# 13,200 V.
1—18,000 KW 200# 13,800 V.
1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext/170# Non Cond.
1— 3,000 KW 175# 850 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,250 KW 250# 2400 V. Ext.
1— 1,000 KW 200# 4160 V. N.C. NEW 1948.
2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 400 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS
1—1000 KVA 2400 volts
3— 500 KW 480 volts
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS
2—50,000# 275# (1949)
3—15,000# 275# (1945)
1—400 HP Sec. Hd. 225#
1—300 H.P. 300# (1948)
1—84" HRT 150# (1942)

WATER WHEEL GEN.
1—180 KW 20 F.H. 550 V.

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4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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DIESEL ELECTRIC GENERATOR SETS

CAT. D4400	20 K.W.	A.C.	Excellent
CAT. D13000	75 K.W.	A.C.	Excellent
Hercules DWX	50 K.W.	D.C.	Used & Rebuilt

G. M. 3-71, 4-71, 6-71, and Quads, marine and industrials, new and rebuilt, from $2250.00.

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1—Worth. 740 G.P.M., type WCS-2, 5", 2250 Ft. Hd.
1—Worth. 700 G.P.M., type UNS-1, 6 stage, 6". 1550 Ft. Hd.
2—I. R. 200 G.P.M., 2", 1875 Ft. Hd.

Pumps above are mounted on basis for motor or turbine drive.
We have about 200 various size cent. pumps on hand, turbine, motor, and gasoline driven. Send us your inq.

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3570 KVA Single Ph. 60/25 Cycle Westinghouse with Auxiliaries.

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NEW Buffalo Forge type SSLD, size 5½, induced draft fan rated 17,000 cfm, 2" s.p., 400 deg. F. at 1160 rpm.

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WELLSVILLE, N. Y.

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2. Careful Testing
3. Honest Guarantee
4. Save Money Safely
5. Quick Shipment
6. Complete Quotations

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G. E. 25 cycle	ATB	2300	750
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis. Ch.	1 brg.	480	400
375 *	G. E.	ATI	240/480	1200
350	El. Machy.	1 phase.	480	1200
312	Gen. Elec.	ATB	240/480	600
275 *	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b	EW	350	1200
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC	250	1800
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
75	Gen. Elec. (2)	CD115	250	1500
75	Whse.	SK	250	1200
60	Whse.	SK160	250	1000
50	Allis. Ch.	EW	125/250	1200
50	Gen. Elec.	RC	125	1200
40	Gen. Elec.	RC	600	1750
40	Gen. Elec.	RC	250	1750
25	Whse.	SK93	125	1750
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

D.C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	250	500
300	Allis. Ch. b.b.	EW	350	1000
200	Al. Ch. b.b.	E	250	500/1000
150	Gen. Elec.	RC36	230	1700
150	Gen. Elec.	RC39	230	550
100	Gen. Elec.	CD115	230	1750
75	Gen. Elec.	RC	230	1700
75	Whse.	SK170	230	635
75	G. E. (2)	CD 115	230	1150
75	Whse.	SK163	230	850
60/75	Gen. Elec.	C	230	500/1200
50	Reliance b.b.	651T	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Gen. Elec.	RC33	115	1100
40	Gen. Elec.	RC32	230	1100
35	G. E.	RF-14	230	250/1000
30	Imperial b.b.	D69	230	400/1600
30	Gen. Elec.	LC	230	500/1500
30	Whse.	SK110L	230	1150
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD85	230	1750
25	Gen. Elec.	CD105	230	575/1725
20	Century bb.	DN336	230	3500
20	G. E. series	CO-1826	230	875
20	Whse. b.b. (2)	SK97	550	900

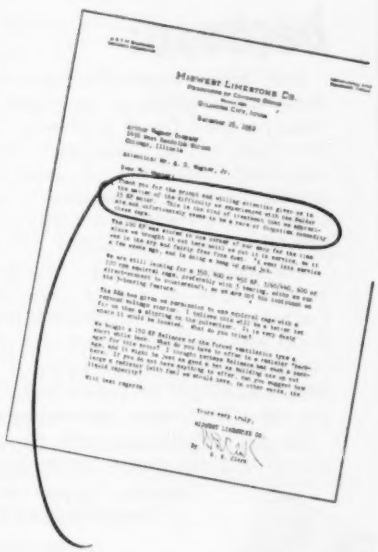
A. C. MOTORS

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E.	Synch.	2200	514
650	E. M.	Synch.	480	1200
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
500	G. E.	Slipring	2200/440	450
500	Al. Ch.	Synch.	440	400
450	Whse.	Synch.	2300	900
400	Whse.	Sq. Cage	2200	514
400	G. E.	Sq. Cage	2200	1800
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200	1200
350	G. E.	Slipring	2200/440	300
350	Whse.	Slipring	2300	450
300	G. E.	Slipring	440	600
300	Al. Ch.	Sq. Cage	2200/440	720
300	El. Mach.	Synch.	2200/440	360
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E.	Slipring	2300	450
250	G. E.	Slipring	440	600
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Whse. XP	Sq. Cage	2200/440	1200
200	G. E.	Slipring	220/440	514
200	G. E.	Sq. Cage	220/440	600
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slip Rings	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Sq. Cage	220/440	1200
200	Al. Ch.	Synch.	440	360
200	G. E.	Slipring	220/440	360
200	G. E.	Sq. Cage	220/440	1800
200	Rel. b.b.	Sq. Cage	220/440	1200
200	E. M.	Synch.	220/440	514
160	Whse.	Synch.	220/440	600
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis. Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis. Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
125	E. M. (2)	Synch.	220/440	1800
125	Allis. Ch.	Sq. Cage	2200	900
125	G. E.	Slipring	2200/440	720

M-G SETS

KW	Mfr.	Input V		Output V
500	Whse.*	2300	AC	250 DC
360	G. E.*	2300/4000	AC	250 DC
300	Allis. Ch.	2200/440	AC	125/250 DC
300	Whse.*	2300	AC	600 DC
250	Allis. Ch.	440	AC	350 DC
200	Whse.* (2)	220/440	AC	55 DC
200	G. E.*	220/440	AC	250 DC
200	Gen. Elec.*	220/440	AC	125 DC
150	Whse.*	220/440	AC	125/250 DC
125	Gen. Elec.	220/440	AC	240 DC
105	Century b.b.	220/440	AC	70 DC
100	Whse.*	2300/4000	AC	275 DC
100	Al. Ch.	220/440	AC	125 DC
100	Delco b.b.	220/440	AC	125/250 DC
100	Allis. Ch.*	220/440	AC	50 DC
75	Whse.	220/440	AC	250 DC
60	Gen. Elec.*	220/440	AC	60 DC
50	Gen. Elec.	220/440	AC	125 DC
50	Allis. Ch.	220/440	AC	125/250 DC
45	Gen. Elec.*	220/440	AC	60 DC
40	Gen. Elec.	220/440	AC	250 DC
30	Otis (5)	220/440	AC	250 DC
25	Whse.	220/440	AC	125 DC
20	N. W.	220/440	AC	250 DC
20	Whse.	220/440	AC	600 DC
21	Whse.	220/440	AC	35 DC
17	Gen. Elec.	220/440	AC	125 DC

THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK.



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2—DC 55 V. 3600 Amp. M-G Sets

Input—300 H.P. Whse. synch. motor, 3/60/220/440 V. 720 RPM, w/exciter.

Output—200 KW. generator, DC 55 V. 3636 amp. 720 RPM, w/exciter.

Each with manual reduced voltage starter

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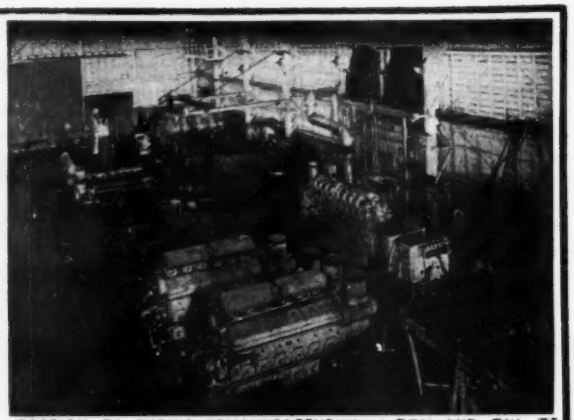

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1980	Nordberg	TS-217	3000	225
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
400	Ingersoll-Rand	S-8	600	720
350	Baldwin	VO-6	510	450
320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
250	Fairbanks Morse	33-D	375	360
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
100	Fairbanks Morse	38E	150	1200
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR **GUARANTEE!**

FOR SALE

IMMEDIATE DELIVERY

2—FAIRBANKS-MORSE, Diesel Opposed Piston, 38D8 ⅛, 1600 HP., @ 720-RPM., at 800 RPM., 1800 HP., Port and Starboard Engines: Complete, all Auxiliaries: With or without Reduction Gears. Serials, 841558, 841559.

Lloyd's (London) Inspection Report on Request.

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STATIONARY DIESELS

2—American Locomotive Heavy Duty, Late Type, 6 Cylinder, 12½"x13", Supercharged, 700 HP @ 600 RPM, or 600 HP @ 500 RPM.

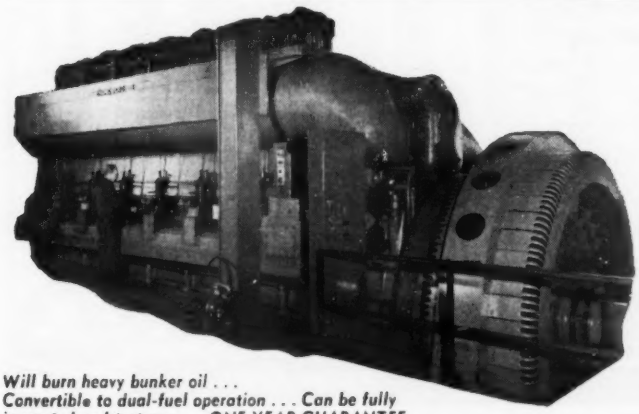
2—Cooper-Bessemer, Type GN, 6 Cylinder, 10½"x13½", 440 BHP @ 650 RPM or 340 HP @ 500 RPM.

SUNDFELT EQUIPMENT COMPANY, INC.
220 HUDSON STREET
SEATTLE 4, WASH.

CURRENT MODEL · · DIESEL

1980 KW NORDBERG MODEL TS-217 DIESEL UNIT

Heavy Duty • Slow Speed • Available Immediately



Will burn heavy bunker oil . . .
Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21½" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake exhaust, water, lubricating oil, fuel oil, and air. Generator and exciter control switchgear.

The unit above affords a rare opportunity to procure a complete, modern current model, heavy duty, slow speed diesel set at a great saving. It represents an offering which cannot be duplicated anywhere in the diesel market today.

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LEA Offers You

M-G SETS—3 ph. 60 cy. Drive

1—750 KW G.E. 550V D.C. MPC., Syn. Dr.
1—500 KW G.E. 250V D.C. MPC., Syn. Dr.
7—400 KW West. SK. 125V. D.C.
2—200 KW West. SK. 250V. D.C.
2—150 KW West. SK. 250V. D.C.
1—150 KW G.E. 250V. MP.C.
1—100 KW West. SK. 125V. D.C.
2— 75 KW West. SK. 125V. D.C.
95 other AC-DC Units

SQ. CAGE MOTORS 3 ph. 60 cy. 440 V

1—400 HP West. MS. 400 RPM

SQ. CAGE MOTORS

1—300 HP A.C. "AN" 1200 RPM
1—250 HP Ideal 600 RPM
1—150 HP A.C. T.E.P.C. 1800 RPM
1—150 HP G.E. I-K-17 450 RPM
500 Other Small Sizes

25 cy. 3/440 V SLIP RING MOTORS

1—800 HP, 1—600 HP
1—400 HP, G.E. 750 RPM
1—300 HP A.C. 500 RPM
1—225 HP G.E. I.T.C. 500 RPM
1—300 KVA Frequency Changer, G.E. ATI. 3 ph. 25 to 60 cy., or 60 to 25 cy. 440 to 440V.

Controls for the above can also be supplied . . . 4000 other units in stock. Write us.

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Superior 7-0747

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
200	1800	GE	SC	K63338 TEFC
150	1800	GE	SR	M-6328 TEFC
150	720	Allis-Chal.	SR	AR-Hoist
150	720	West.	SC	CS
125	3600	Elliott	SC 2200 V.	9NS02
125	600	GE	Syn.	T8-DC Exciter
100	1800	GE	SR	IM
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn. 2200 V.	T8-DC Exciter
100(2)	1200	GE	SC	I-K
75	1200	Wagner	SC	24-W
75	900	AC	SC	AR-BB
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	GE	SC	I-K
60(2)	3600	GE & W	SC	K&C8 4448B
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
60	900	AC	SC 2200 V.	ARZ-TEFC
50	1800	GE	SC	IK
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	900	GE	SC	IK
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405a Exp. Pr.
40	1800	GE	SC	KT
40(2)	1200	Rel.&West.	SC	Fr 445-BB
40(2)	1200	FM	SR	HV-BB
40(2)	1200	AC&Rel.	SC	TEFC-BB
40	900	West.	SR	CW
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC
30	1200	CW	SC	SC-BB
25	1200	Howell	SC	KBB-405 TEFC

SPECIALS

1—500 KVA Trans. West'hse Type ASL, 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical Items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount—Freight allowed. **SEND US YOUR INQUIRIES.**

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SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make		Speed
600	2200	Whse.		450
580	2300/4000	G.E.		900
450	440	Whse.		514
300	440	G.E.	(hoist)	600
300	2300/440	Whse.	(new)	600
300	2200	G.E.		300
300	440	Whse.		3600
250	4000/2300	G.E.		450
250	440/220	Whse.		600
250	550/440	G.E.		1200
250	440	G.E.		600
200	440/220	Whse.		514
200	440	G.E.		450
188	4000/2300	G.E.		1800
150	2300/440	G.E.		600
150	550/220	G.E.		720
145	4000/2300	G.E.		1800
135	440/220	G.E.	(hoist)	600
125	440/220	G.E.		900
125	550/440	G.E.		1200
125	2200	G.E.		600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	2200/440	G.E.	ATI	720
300	2300/440	G.E.	TS	720
300	2300/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
240	2300/440	G.E.	ATI	720
225	440/220	Whse.	HR	360
200	4150/2300	Whse.	Q	1800
125	440/220	Whse.	HR	400
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	G.E. (25 cy.)	TS	375
75	2200/440	Whse.	GE	600

CIRCUIT BREAKERS

3—2000 amp., GG E., 3 pole, 600 v
3—1600 amp., ITE, 3 pole, 600 v.

200 KW GE RECTIFIER UNIT

1—new—Ignitron type, 250/275 V. DC, 4000/2300 V. AC, 3 ph., complete all accessories including transformer, switch gear, etc.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2300	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
250	2300	G.E.	KT	1200
200	2200	L. Allis	FS	1800
300	2200	G.E.	FT	3600
250	2200/440	G.E.	IK	720
225 (2)	2200/440	G.E.	KT	1200
200	2200/440	G.E.	K	1200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	IK	600
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G.E.	IK	450
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/2200	G.E.	IK	514
150	2200/440	G.E.	KT	600
125	440/220	G.E.	KT(vert.)	1200
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—200 kva, 720 rpm, 2200/440 V., G.E. (Ball brg.)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
150	220	G.E.	CD	1750
150	230	Whse.	SK	850
120	230	Whse.	SK	350/1050
100	230	El. Dyn.	30-3	475/1250
100	230	Cr. Wh.	CMC	625
90	230	G.E.	CD	1750
80	230	G.E.	BC	600
50	220	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V.. AC	Motor Type	Output V.. DC
250	Whse.	2200	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440	sq.ca.	250
100	Al. Ch.	2200/440	sq.ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G.E.	2200/440	syn.	125
65	G.E.	2200/440	sq-ca.	250
65	G.E.	2200/440	sq.ca.	125
60	G.E.	440/220	sq.ca.	250/125
45	G.E.	440/220	sq.ca.	250
40	G.E.	440/220	sq.ca.	250/125

TRANSFORMERS 60 CY.

3— 500 kva, Whse., 24000—2300 V.
1— 300 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
3— 200 kva, G.E., 11000—2300 V.
3— 200 kva, G.E., 4150—480/240 V.
3— 150 kva, G.E., 25000—2300/4600 V.
3— 150 kva, Al. Chal., 2400—240/480 V.
3— 150 kva, Al. Chal., 2400-240/120 V.
3— 100 kva, Whse., 2400-240/480 V.
6— 100 kva, Whse., 2400—120/240 V.
5— 100 kva, G.E., 4150—120/240 V.
2— 100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 50 kva, Whse., 440—220/110 V., dry
6— 50 kva., G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/230 V., dry

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Elesco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.
1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.
2—8000 HP Webster Water Heaters.
1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.
6—Steel Coal Bunkers, 80 tons each.
1—30" Wheeler Single Stage Circulating Pump, 30,000 GPM direct connected to 300 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)
1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam turbine.
1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis Steam Turbine, 2-stage with reduction gear, Type SO, 3000 to 1200 RPM.
1—Type 1A-80 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-Stage Steam Turbine, 1750 RPM.
1—8" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-Stage Steam Turbine, 1800 RPM.
1—Combination Circulating Pump and Condensate Pump driven by 100 HP General Electric single Stage Steam Turbine through a Westinghouse Reduction Gear, 3500 to 700 RPM.
1—2" 2-stage LeCourtney Centrifugal Pump, 200 GPM 650' Head at 3700 RPM direct connected to 55 HP Westinghouse Steam Turbine.
1—3000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 250 RPM, 600 Volts DC with 1—3150 KVA General Electric Transformer, 3 phase, 25 cycle, 6600/13200-445 Volts with starting panel and all instruments.
1—1600 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 750 RPM 600 Volts DC with 1-1650 KVA General Electric Transformer, 3 phase, 25 cycle, 13200/445 volts with starting panel and instruments.
1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.
1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 13200/6600 volts.
7—700 KVA Westinghouse Transformers, single phase, 25 cycle, 7620/6600 volts to 13200 volts.
1—Kennecott Pressure Type Industrial Water Filter.
1—50-Ton Electric Traveling Crane—35'5½" Span.

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SUPERIOR HEAVY DUTY DIESEL

510 HP[1] at 360 RPM—5 cylinder—14½x18—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile and saw mills, mining, etc. EXCELLENT CONDITION. IMMEDIATE DELIVERY.

30 KW GM 3-71 DIESEL GENERATOR SET

GM 2 cylinder 4½x5 diesel—radiator cooled—electric starting. Delco 3/60/440 generator—with switchgear. Skid mounted—portable.

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SURPLUS BOILERS [A-1 Condition]

100,000# hr. Sterling 450#, 125° SH
87,000# hr. Maximum Bent tube, 350#
60,000# hr. Bent tube, 275#. Water Walls
55,000 to 75,000#, Sect. Header, 450# SH
900 HP Cross Drum, 400#, 150° SH
850 HP & 750 HP Sterling 250# (several)

And others 200-250# pressure

TURBO GENERATOR UNITS 200-450#
Condensing, Non. Cond., Extraction

Diesel Sets, Transformers, Engines

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630 Ft. Washington Ave., New York 33, N.Y.

SUGAR MILL SPECIALS

2—1000, 2—600, 2—500 H.P., 225 lbs.
1—50000 lb, 450 lbs. pressure, all forged steel header, B&W sectional header water tube boilers, easy to erect.
1—500 H.P. Cleaver-Brookes package boilers.
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8—12,000-17,000 & 20,000 Gal. 90 Lb.
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9—42,000, 120,000 & 240,000 Gal. Storage

LESTAN CORP., ROSEMONT, PA.

1—300 KW Motor Generator Set—Complete
1—200 KW GE Late Type Rotary Converter
1—20-40-50-100-125 HP Steam Generators
1—30 Ton 75' Span O.E.T. Crane w/motors
1—75 & 60 HP TEFC Motors—Rebuilt
1—10'x1½" Robinson Power Brake
2—130'x5' dia. Steel Smoke Stacks
1—300 HP 600# P. B&W W.T. Boilers—1946

H. & P., 6719 Etzel, St. Louis 14, Mo.

1500 KW RECTIFIER

Mercury Arc. Ignitron 1500V. DC, Automatic AC 3/60/44,000, NEW in 1941. First Class, Complete WESTINGHOUSE Sub Station.

VERY REASONABLE PRICE

S. M. DAVIS

510 LaSalle St. St. Louis 4, Mo.

NEW TRANSFORMERS—25 & 50 KVA

GE, OISC, Distribution Type "H". Form KO2, single ph., 50/60 cyc., 33,000 volts primary, 2400/4160 Y secondary, with 4—2½% taps below 33,000 volts, primary cover mounted bushings, secondary tank-wall mounted bushings. S/N 6,900,000.

American Electric Service & Maintenance Co.
Paramount & 2nd Sts., Springfield, Mass.
2-2104; 2-2105
Motors • Generators • Transformers • Sales • Repairs

A. C. MOTORS
220/440 Volt 3 Phase 60 Cycle

HP	Make	RPM	Type
525	Elliott	720	Syn.
450	Elliott	720	Syn.
400	Westg.	600	CS-1214
350	Westg.	450	CS
350	Westg.	585	CS
350	G. E.	720	Syn.
300	Westg.	400	CS-1214
300	G. E.	1800	2200/4100 V
250	Burke	720	Syn.
250	G. E.	1200	KT-563
225	Elec. Machy.	1800	Syn.
200	Westg.	291	CS-1214A
200	Wagner	1800	RP
200	G. E.	1800	Syn.
175	Westg.	720	CS
150	Westg.	257	Syn.
150	Westg.	585	CS
150	Westg.	600	Syn.
150	Cr. Wh.	860	
150	Elec. Prod.	900	Syn.
150 NEW	Reliance	1200	AA-6085S
150	G. E.	1750	2200V.
150 VERT.	G. E.	1750	2200V.
150 NEW	Westg.	1760	2300V.
150	Wagner	1800	tot. enc.
125	Elec. Mach.	164	Syn.
125	Cr. Wh.	720	
125	Wagner	1150	RP
125	Westg.	1750	CS-761C
100	Cr. Wh.	600	
100	Wagner	860	
100	G. E.	900	I-K
100 NEW	Reliance	1170	TEFC
100 NEW	Reliance	1170	AA-5084S
100 NEW	Reliance	1800	TEFC
100 NEW	Reliance	1800	
100	G. E.	1800	K-504S
100	Westg.	1800	Syn.
75 NEW	Reliance	875	AA-5084
75	Elec. Machy.	900	Syn.
75 NEW	Reliance	1170	TEFC
75 NEW	Reliance	1170	AA-505
75	G. E.	1800	I-K
75	Louis Allis	1800	splash proof.
75 NEW	Reliance	1800	TEFC
60	G. E.	900	KT-542
60	Westg.	1200	CS
60 NEW	Reliance	1165	AA-504U
60 NEW	Reliance	1755	
60	G. E.	450	I-K
50	G. E.	1800	KT-333
50	Westg.	720	CS
50	G. E.	850	KT-542
50 NEW	Reliance	1165	TEFC
50 NEW	Reliance	1165	AA-445
50 NEW	Reliance	1750	AA-405S
40	G. E.	3600	K-405 S

VARIABLE SPEED MOTORS
230 Volt D. C.

HP	Make	RPM	Type
400	G. E.	400/1200	MPC.
400	Al. Ch.	400/1200	
125	West.	125/ 500	RB Anti-Fric.
75/100	West.	600/1200	SA-13L SB
75	Cr. Wh.	860/1720	TEFC BB
50	G. E.	600/1200	LC
50	Westg.	350/1050	SK-170
50	Cr. Wh.	300/1200	CMC SB
40/50	Reliance	600/1200	T-310T
40/50	Rel.	500/1500	T-461T BB
40	West.	750/1500	SK-140
40	Rel.	500/1500	T-461 FTEFCBB
40	Rel.	400/1600	T-651 FTEFCBB
40	El.G.Co.	385/1200	Frame 180S
35	G. E.	625/2100	COM-1829AE
35	G. E.	350/1450	RF-162 SS
35	Westg.	250/1000	SK-131
30/40	Imperial	400/1600	D-D69 BB DP
30/40	Rel.	300/1200	T-651% TE BB
30	West.	1150/1750	SK-133 TEFCBB
30	Rel.	400/1600	T-461 FTEFCBB
30	Imperial	400/1600	D-D69 BB DP

SLIP RING MOTORS
220/440 V. 3 ph., 60 cy.

HP	Make	RPM	Type
1750	G. E.	900	MT
1500	G. E.	900	MT
1250	G. E.	900	MT
400	Westg.	438	2200V.
350	G. E.	710	MT-575
200	G. E.	600	IM 2200 V.
200	Cr. Wh.	590	
200	West.	500	CW
150	G. E.	705	IM 2200 V.
150	Westg.	1140	CW-873C
75	Westg.	870	CW
60	G. E.	570	MTC
50	G. E.	865	MT-346

TRANSFORMERS—1 ph. 60 cy.

No.	KVA	Make	Primary	Secondary
4	15	G. E.	2200	110/220
10	25	G. E.	2200	110/220
3	25	West.	2200	110/220
1	30	G. E.	2200	110/220
9	37½	G. E.	2200	110/220
2	40	G. E.	2200	110/220
11	50	G. E.	2200	110/220
3	50	West.	2200	110/220
3	75	West.	2400	120/240
1	75	West.	13200/6600	2300
1	75	Pittsburgh	4600	115/230
1	100	Pittsburgh	2300/4600	115/230
6	100	Pittsburgh	4600	115/230
1	100	West.	2300	230/460
2	150	Pittsburgh	4600	115/230
3	200	All. Chal.	22000	2300
1 New	250	Packard	2300	230
2	250	G. E.	2400	480

G. E. RECTIFIER TRANSFORMER
890 KVA, 1110 KVA 2 hrs. Type HTH, Form D, 60 cy., 2300 volts pri., 242 volts sec., (line to neutral), 6.74% impedance.

DUQUESNE ELECTRIC & MFG. CO.
Cor. Broad St. & Hamilton Ave.
Pittsburgh 6, Pennsylvania
Partial Listing — Write for Stocksheet

THE TRADE MARK WITH A MEANING
SUCCESSFUL OPERATION GUARANTEED
*45th Year of Service—Member of A.R.A.**

A. C. MOTORS
3 ph. 60 Cycle
SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1—	5000	Whse.		2500/5000	600
1—	4350	Cr. Wh.		4160/13800	514
2—	3500	G. E.	TS	2300	257
1—	2500	G. E.	ATI	2300	720
2—	2100	G. E.	ATI	2300	360
2—	2000	Whse.		2300	120
2—	1750	G. E.	ATI	2300	3600
3—	735	G. E.	ATI	2200/12000	600
1—	500	Ideal	SM	2300/4150	1800
1—	450	Whse.	Eng.	2200	128.5
1—	450	Whse.		2300	450
2—	350	G. E.	TS	2200	150
1—	300	Whse.		2300	720
1—	150	Whse.		440	600

SLIP RING

1—	1800	G. E.	MT-498	2300	360
1—	1500	ABB		2300	720
1—	1200	G. E.	MF-26	2300	275
2—	1000	A. C.	Mill	2300	240
1—	500	Whse.	CW	500	360
2—	500	G. E. unused	M-574Y	2200	900
1—	500	G. E.	IM	440	900
1—	400	Whse.	CW-1218	2200	435
1—	400	Whse.	CW	440	514
1—	350	G. E.	MT-442Y	2300/4000	253
2—	300	G. E.	MT-565Y	2300	900
1—	300	A. C.		440	505
1—	250	G. E.	MT-424Y	4000	250
1—	250	G. E.	MT-559S	2200	1750
1—	250	A. C.		550	600
1—	200	Cr. Wh.	26QB	440	505
1—	200	G. E.	IM	410	435
1—	200	G. E.	MTP	410	1170
1—	200	Whse.	CW	410	490
1—	200	G. E.	IM	440	600
1—	150new	Whse.	CW	2300	450
1—	150	G. E.	IM-16	440	600
2—	125	A. C.		440	865
1—	125	A. C.		440	720
4—	125	G. E.	MT-566Y	440/2200	435
2—	100	G. E.	IM	440	600

SQUIRREL CAGE

2—	650	G. E.	FT559BY	440	3750
2—	450	Whse.	CS	2300/4150	354
1—	200	G. E.	IK-17	400	580
3—	200	G. E.	KT-557	410	1800
1—	200	G. E.	KT-550Y	2300	1200
1—	200	G. E.	IK	440	865
1—	75/150	G. E.	IK	440	450/900
1—	150	Whse.	CS	440	580
1—	150	Wstghse.	CS856S	410	830
1—	125	Whse.	MS	440	485
1—	125	G. E.	KF-TEFC	440	3585
2—	125	At. Ch.	ARW	2200	1750

D.C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
1—	2200	G. E.	MCF	600	360/500
1—	2000	Whse.	Mill	600	230/460
1—	910	Whse.	QM R Brg.	250	140/170
1—	900	Whse.		250	450/550
1—	825	Whse.	Mill	250	90/180
1—	600	A. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G. E.	MCF	550	300/1050
2—	300/400	G. E.	DYNA	230	1325/2500
2—	300	Whse.	CB-5094	230	575/1150
1—	200/300	G. E.	MPC	230	360/920
1—	250	G. E.	MPC	230	400/500
1—	200	Rel.	1970T	230	720
1—	200	Whse.	CB-5113	230	400/800
1—	150	G. E.		600	250/750
8—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
1—	150	Whse.	SK-151 B	230	900/1800
1—	150	Whse.	CB-2073	230	525/1150
1—	50/120	G. E.	MFC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
1—	60	El. Dy.	25-S	230	525/1050
2—	50/60	Whse.	SK-170	230	400/1200
1—	50	G. E.	CO-1810	230	725
1—	50	Whse.	SK-170	230	350/1050
2—	50	G. E.	RCP-31B	230	1700

MOTOR GENERATOR SET
3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G. E.	514	600	13800/4000
2	2000*	G. E.	500	600	6600/11000
3	1500	G. E.	514	250	4000/13200
1	1500	G. E.	720	600	6600/13200
1	1500	G. E.	360	275	2300/4400
1	1500	G. E.	600	600	2300/4150
1	1500	C. W.	514	115	4160/13800
1	1200	A. C.	720	550	2300
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000(3U)	G. E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C. W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G. E.	1175	125	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
2	35	Whse.	1750	125/250	2200

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G. E.	25/6C	4000/2300x2300/4000
1—	2000	G. E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P 5/20# G. Ext. Surface Condenser—3/60/2300.
	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
	750	G. E.	Condensing 425#-725*TT I.S.P. 440 V. 3 ph. 60 cy. New—1944
	750	Whse.	Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
	400	Whse.	Non-condensing 125/150# I.S.P. 5/10# G.B.P., 240/480v. 3 ph. 60 cy.
	300	G.E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V. 3 ph. 60 cy.
	200	Whse.	Non, condensing 150# I.S.P. 7# B.P. 240 V. 3 ph. 60 cy.

TRANSFORMERS
60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	33000x26400/13200
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
3	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
3	1250	G. E.	H	1	6600x550
1	1150	A. C.	OISC	3	13200x2300/480
2	1000	Pitts.	OISC	3	2300x460
3	1000	Wagner	OISC	1	13200x220/440
2	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OISC	1	13200x120/240
3	150	Whse.	OISC	1	33000x2300/4000
1	150	G. E.	HT	3	25000x125/216
3	100	G. E.	OISC	1	2400x120/240
2	75	Upte	OISC	3	4160x240
1	50	Mol.	Askerel	3	13200x120/208
3	25	A. C.	OISC	1	4000x230/460

***American Rebuilders Association — Member Body of A.S.A.**

BELYEA COMPANY, INC.
OFFICE AND SHOP
43 HOWELL ST., JERSEY CITY 6, N. J.
PHONE JO 2-3334 — N. Y. CITY LINE RE 2-7150

LAND'S 44th YEAR
MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE

GENERATORS—250 V. D. C. Motor Driven

KW	Make	Type	Speed
2000	G. E.	New	900
1150	G. E.	New	900
1000	Al. Ch.		720
250	Cr. Wh.	CCD	1200
150	West.	SK	900
125	G. E. (3)	MPC	1200
125	El. Dy.	20L	1750
100	Delco (4)		1150
75	Cr. Wh.	51H	1150
50	Cr. Wh.	HH	1150
40	West.	SK	1750
35	Al. Ch. (4)	3 wire	1750
25	G. E.	C8	1200
17	G. E.	RC	1750
15	Star		1750
7½	West.	SK-43	1750
5	West.	SK-284	1750
5	Rel.	T-23T	1750
3	Rel.	T-14T	1740

GENERATORS—Low Voltage D.C.

Amp.	Make	Voltag
10,000/5000	H-V-W	6/1e
3000/1500	Chandey.	12/22
2500/1250	Chandey.	6/14
1500	H-V-W	6/12
750	H-V-W	6/12
4000/2000	North.	7½/12
3000/1500	Chandey.	8/15
10,000	J-L	16
1000	G. E.	10
6000/3000	El. Prod.	18/35
1000	G. E.	26
1000	West.	25
100	Diehl	34
200	West.	32
200	Burke	35
125	Diehl	45
500	G. E.	30
1500	Century	42
3200	G. E.	55
325	West.	50
1000	G. E.	70
		5

230 V. D.C. MOTORS

H.P.	Make	Type	Speed
350	G. E. (2)	MDP 422	375/750
250	G. E.	MDP 420	410/820
250/200	Rel.	2600T	400/800
150	West.	SK	1150
150	West.	SK	850
125	Rel.	T	600
125/50	E. D.	20-8L	1750/1315
100	West. (4)	SK	1150
100	West. (6)	SK	850
100	Rel.	651-T	850
100	G. E.	RC	600
100	Rel.	1060T	500
100	A-C		1150
100	FM	TRC-38	725
90/45	G. E. (2)	RF-17	950/475
75	G. E.	CD-155	1150
75	West. (6)	SK	1150
75	G. E.	RC	1000
75	Rel.	461-T	850
75	West. (2)	SK	850
75	West.	SK	475
75	Cr. Wh.	CMC-125H	375/950
60	West.	SK	850
60	West.	SK-160	680
60	West.	SK	250/1000
50	Cr. Wh.	CMC-FH	1750
50	G. E.	CD-93	3600
50	West.	SK-160	565
50	G. E.	RF-17	250/1000
40	G. E. (3)	CD-105	850
40	Cr. Wh.	FH	1750
40	West. (5)	SK	775
35	E-D	258	350/1050
35	West.	SK	250/1050
35	West.	SK	1150

SLIPRING MOTORS

H.P.	Make	Type	Speed
600	Cr. Wh.	131-AQ	507
500	G. E.	IM	720
500	G. E. (2)	IM	450
200	G. E.	MT-559Y	1175
150	G. E.	IM	870
125	West.	CW	1750
125	G. E.	IM	580
100	G. E.	MT347	1150
100	G. E.	IM	690

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
250	GE(TENV)	K-6335	1750
200	Wagner	RP2-26Z	1800
200	West.		1750
200	A. Ch.	AR	865
200	G. E.	KF-6335	880
150	West.	C8	1175
150	G. E.	IK	580
125	A. Ch. (2)	53R	3500
125	A. Ch. (5)	AR	1890
125	Century		3500
125	A. Ch.		690
100	West.	CS607S	3540
100	West.	C8	870

Partial Listing Only!

Please Send Us Your Inquiries

L. J. LAND, INC.

Established 1910

156 Grand Street, New York 13, N. Y.

CAnal 6-6976

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-607S	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBBused
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	K-594S	1800	TEFCBBXP
60	G.E.	OG-44	1800	TEFCBBXP
60	L.A.	QS-444	1800	B. B. open
60	F.M.	FB-404	3600	B. B. open
50	Master	K-445	1800	TEFCBBXP
50	G.E.	K-405	1800	TEFCBB
50	G.E	CS-445	1200	S. B. drip
50	West.	K-505	900	S B. open
50	G.E.	AR-444	3600	TEFCBBXP
40	A.C.	KF-365S	3600	TEFCBBXP
40	G.E.	CS-405	1800	B. B. Splash
40	West.	K-405	1800	TEFCBB
40	L.A.	404	1800	TEFCBBXP
40	G.E.	CS-504S	1800	B. B. open

REBUILT SQUIRREL CAGE MOTORS

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM. We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER
EQUIPMENT COMPANY

8 CAIRN ST., ROCHESTER 2, N. Y.

P. O. BOX 534 — Tel: Genesee 5629

FOR SALE

300 KW MG Set—4600 V. Syn Motor driven 250 V. 2 wire DC Generator complete with starting and metering equipment.

250 KW Transformer 3 phase two to one 440 V. to 220 V.

75 KW MG Set 3 phase 440 V. motor 250 V. 2 wire DC Generator.

50 KW—40 KW—35 KW, MG Sets same as above item except 220 V. Meter, also starting controlling and metering equipment.

15 Ton Traveling Crane complete Span 49', lift 12', Travel 78' with 2 wire 250 V. D.C. control on motor.

For immediate inspection at

HENRY FORD HOSPITAL
Detroit, Michigan
As Is and Where Is

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW., 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

REFRIGERATION UNITS

TWO PRACTICALLY
NEW WORTHINGTON CARBONDALE
REFRIGERATION COMPRESSORS

300 Ton Freon

Ideal for large plant or office building

WILL SACRIFICE

WINSTON MACHINERY CO., INC.
326 WEST OHIO STREET
INDIANAPOLIS, INDIANA

FOR SALE

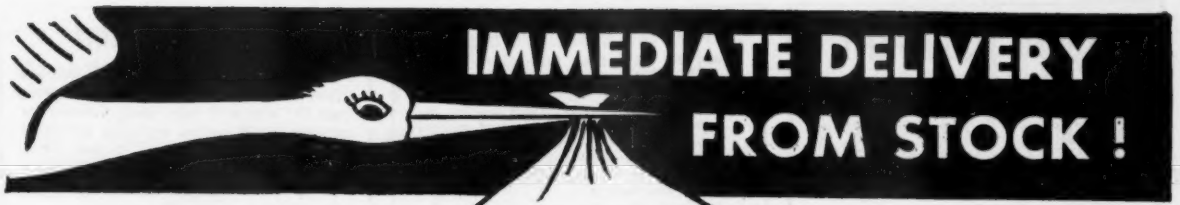
MODERN 1000 KW Turbo-Generator

In excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum. Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.

6101 Tacony St. Philadelphia 24, Pa.



SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	6600	Westinghouse
350	3600	2200	Westinghouse
300	1200	2300/440	Westgh., CS
300	900	440	G.E.
200	490	2200	G.E.,-I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	1200	2300/440	A-C, AR.
100	720	440	Westgh. 3 Brg
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
50	3600	220/440	G.E.-404S
50	1800	220	Triumph
50	720	2200	Westinghouse
40	1800	220/440	West.-444
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.

*New Motors

4 SPEED MOTORS AND CONTROL

Century, Model SCNM504Y90!AV, 20 HP, 440 volt, 3 Phase, 60 Cycle, 1700/1120/870/560 RPM. Multi-speed, ball bearing. With plugging switch mounted on shaft; motors on adjustable hinge bases. Control —Allen Bradley, Magnetic.

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-Cw
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	514	440	Al. Ch. 3 Brg.
250	600	2200	G.E.-117B
250	450	2200	C.-W.
250	450	2200	G.E.-1-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	West.-CW
200	600	440	G.E.-IM
200	514	440	West.-CW
150	1800	2200	FM-HV
150	720	2200	Al. Ch.
150	600	220	Wagner
125	1750	2200	West., CW
120	900	550	Ideal
100	720	440	Al. Ch.
100	600	2200	G.E. MT-562
100	600	220	Wagner
100	400	440	West. Elec. (GE)

*New

Special

FREQUENCY CHANGER

2500 KW General Electric
2300 volt, 3 phase, 25 cycle,
4000 volt, 3 phase, 60 cycle,
300 RPM.

MOTOR GENERATOR SETS

D.C. OUTPUT			A.C. INPUT		
KW	Voltage	Description	HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
1200	525	Al. Ch.-G.E.	2000	720	2300
800	500	West., 3 unit	1200	1200	2300
800	250	Westgh.	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
750	250	Westgh.	1070	900	13200
600	250	Westgh. (2-300 KW Gen.)	1200	1200	2300
600	250	G.E.	900	900	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.,-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.,-Westgh.	300	1200	440
100	250	Delco-Westgh.	150	1200	220
100	250	G.E.	150	1200	220/440
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
35	125	G.E.	50	1800	2200
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	HP	VOLTS	A.C. END DESCR
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	290	440	WH Sync
1500/750	6/12	1200	Munning Loeb	15	440	GE— I Cage
1200	60	1160	Century	108	220/440	Century, SCN-584
1000	60	1200	Century	100	440	Century Cage
1000	6	1200	Wagner	—	—	—
800	30	900	C-W	40	220	C-W type 1220
680	11	900	Westgh.	15	440	W.H. BB
600	50	500	E-M	40	440	A-C
600	30	1200	W-E	30	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6		GE Rect.	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

MEMBERS OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

Glow Electric Company

927 HARRIET ST. CINCINNATI 3, OHIO PHONE MAIN 3024

N.I.S.E. NATIONAL INDUSTRIAL SERVICE ASSOCIATION

NOW LIQUIDATING

AT MARION, INDIANA

1—Carbondale 10x10 Vert. twin cylinder Ammonia Compressor, 82 ton, 75 HP motor.

1—Taber Fermentation Gas Collector with 8 storage tanks 50 cu. ft., ASME 245# WP.

5—Niagara Spray Cooler and Fan Cooler Units.

1—Rotary Pump 5", with 40 HP motor, 1000 GPM—86' Hd.

22 Welded Steel Storage Tanks (closed) 5500 gal., 10,500 gal., 11,300 gal. and 12,700 gal.

22 Welded Steel Tanks, 16'10" L x 7'7" W x 8'9" deep, open top, flat bottom.

FOR SALE FROM PHILA. STOCK

2—I-R Motorblowers, type FS-538; cap. 4000 CFM @ 3# Pr.

1—Byron Jackson Bronze Deep Well Turbine Pump with 20 HP motor. 150 GPM.

1—I-R #1½-RVH Bronze Centrifugal Motor-pump with 20 HP motor. 200 GPM—200'.

PERRY EQUIPMENT CORP.

1422 N. 6th St. PHILA. 22, PA.

FOR SALE—DIESEL ENGINES

One Enterprise Model DSQ-6, 16 x 20 Diesel Engine. 797 HP. 327 RPM. Direct connected to Elliott AC Generator 1,000 KVA, 800 KW, 2400 volts, 3 phase, 60 cycle with Woodward Governor and all necessary switch gear. Maxim steam generating silencer. 80% Power Factor. Used 14,275 hours.

One Enterprise Model DSQ-8, 16 x 20 Diesel Engine, 1075 HP. 327 RPM. Direct connected to Elliott AC Generator 1400 KVA, 2400 volts, 3 phase, 60 cycle with Woodward Governor and all necessary switch gear. Maxim steam generating silencer. 80% Power Factor. Used 17,423 hours.

One Fairbanks-Morse Model 32-E, 14 x 17 Diesel Engine. 300 HP, 300 RPM. Direct connected to FM Generator, type TGZ-6, 250 KVA, 3 phase, 60 cycle, 440 volts with Woodward Governor and all necessary switch gear and silencer. Used 27,000 hours.

One Fairbanks-Morse Model 32-E Diesel Engine, 120 HP. Direct connected to 75 KW, 3 phase, 6 cycle, 440 volt generator. With Woodward governor and all necessary switch gear and silencer.

Municipal notes or bonds accepted in payment.

Dealer Inquiries Invited

NYLEN PRODUCTS COMPANY

ST. JOSEPH, MICHIGAN

POWER EQUIPMENT

TURBINE UNITS

1—5000 KVA G.E. 3/60/2300/4000 V. 3600 RPM STRAIGHT CONDENSING nozzled for 450 psig 750° TT. Surface condenser.

1—3750 KVA G.E. 3/60/2300/4000 V. 3600 RPM STRAIGHT CONDENSING nozzled for 200 psig 550° TT. Suface Condenser.

1—3750 KVA West. 3/60/2300/4000 V. 3600 RPM STRAIGHT CONDENSING nozzled 375 psig 575° TT, 11.75# water rate, surf. cond.

1—1250 KVA Al.Ch. 3/60/480 V. 3600 RPM. Terry EXTRACTION turbine nozzled 250 psig 550° TT, 40,000# extr. 25 psig, surf. cond.

BOILERS

1—90,000# Springfield sectional header cross drum 400# WP 750° TT new stoker fired.

1—50,000# Edgemoor bent tube 255# WP 490° TT Coxe chain grate stoker and economizer. New 1939.

2—502 HP Heine water leg type 200# WP 480° TT Coxe chain grate stokers. New 1929.

DIESEL ENGINE UNITS

1—2800 HP Nordberg 6900 V. 60 cy.

1—2000 HP Fairbanks Morse 6900 V. 60 cy.

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.

1— 250 HP Buckeye 240 V. 60 cy.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	V.—DC	A.C.	RPM
1	3000	G. E.	250	13200	514
1	1500	G. E.	600	4150	600
2	1000	West.	600	4150	900
1	200	West.	275	2200	900
2	200	G. E.	250	4150	1200
2	150	G. E.	250	2300	1200
1	75	Ridgway	125	229	1200

SYNCHRONOUS MOTORS

QU.	HP	MFR.	VOLTAGE	RPM
1	3800	G. E.	6600	360
2	700	West.	2300	200
1	600	G. E.	2300	240
1	300	G. E.	2300	600
1	300	West.	2300	900
4	125	G.E.	2300	720

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
2	6875	West.	25/62½	375
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300

OIL CIRCUIT BREAKERS—Outdoor

2— 400 A. 37 KV G.E. FHKO-136-350
1— 400 A. 37 KV G.E. FHKO-236-500
4— 600 A. 15 KV G.E. FHKO-139-750
1—1200 A. 15 KV G.E. FKO-139-350

TRANSFORMERS

4—	3333 KVA West.	69300/66000—33000
4—	2500 KVA Mel.	69000—13800
6—	2000 KVA G.E.	66000/114000—2400
4—	500 KVA West.	69000—6900
3—	150 KVA Mel.	44000—2400/7200
3—	75 KVA West.	44000—7200/12470 Y
4—	5000 KVA G.E.	40935/70900 Y—14200
2—	5000 KVA West.	33000—26400, 3 ph.
4—	333 KVA G.E.	33000—7200/12470 Y
3—	200 KVA A.C.	33000—2400/7200/12470
3—	150 KVA Wag.	33000—7200/12470 Y
3—	100 KVA West.	33000—240/480 NEW
3—	75 KVA Wag.	33000—7200/12470 Y
6—	2125 KVA G.E.	26400/13200—2300
4—	1500 KVA A.C.	25400/44000—6900/13800
4—	450 KVA A.C.	25410/44000—13280/23000
3—	1250 KVA G.E.	23000—2300/4000
3—	100 KVA G.E.	22000—7200/12470 Y
1—	3000 KVA Stand.	19050/33000—4160, 3 ph.
1—	5000 KVA Pitts.	13200—4600, 3 ph.
1—	450 KVA Penn.	13200—2400, 3 ph.
3—	200 KVA G.E.	13800—2300
3—	250 KVA Pitts.	7200—220/440
3—	100 KVA G.E.	7200—240/480
3—	150 KVA Wag.	6900—2300
3—	37½ KVA G.E.	6900—230/460
4—	150 KVA G.E.	4800/2400—240/120
3—	1500 KVA A.C.	2300/4000 Y—2300
2—	250 KVA West.	2300—460
3—	150 KVA West.	2400—230/115
1—	100 KVA G.E.	2300—575, 3 ph.
6—	50 KVA West.	2400—114/228 DRY TYPE

PARTIAL LIST ONLY

BREW, WOLTMAN & CO., INC.
50 Church St. New York 7, N. Y.

2—750 HP B&W Sterling, 1925, 225# w.p.

2—600 HP B&W Long Drum Sect. Headers, 1921, 200# w.p. Complete with Peabody Burners.

1—500 HP Cleaver-Brooks, 150# pressure. No. 6 oil, complete with pumps and receiver. All trim.

2—500 H.P. B&W 200# w.p. Longitudinal Sectional Header Boilers. Retubed 1952. Location Massachusetts.

1—490 HP Walsh-Weidner sec. Hdr. Cross Drum. 450 lbs. Superheater, etc.

1—400 H.P. Keeler C.P. Integral Type Watertube Boiler with complete Todd Oil Burner Installation. Design Pressure 160#. Built 1940.

2—400 H.P., B. & W. Sectional Steel Header Boilers, 200# w.p., 1921, A.S.M.E.

1—310 HP Keeler "CP" Self-Contained. 160 lbs. With or without STOKERS. Complete Plant.

2—300 HP Cleaver Brooks Package Boiler, 175# w.p. factory overhauled.

3—200 H.P., B&W Cross Drum, sectional steel header, 160# w.p. watertube Boilers with superheat. 1944, 1940, 1939.

1—150 H.P. Cleaver-Brooks, 150# w.p., No. 6 oil, 1946, pump and receiver.

1—50 H.P. Clayton fully auto. Package Unit 99 sq ft. heating surface.

1—Babcock & Wilcox FF-15 Self-contained. 160 lbs. Complete Plant—20,000 lbs. per hr.

Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.

A Number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.

2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating.

Combustion Engrg., Spreader Stoker complete with fan & Hogan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.

3—Elliot Surface Condensers, 1—900 sq. ft. 2—600 sq. ft. Located in New Jersey.

1—500 KW G.E. Turbine, 5 Stage with 625 KVA Alternator, 440 V., 600 sq. ft. Elliot super condenser.

1—300 K.W. Gen. Elec. Turbo-generator set. Completely rebuilt and rewound for 220/440 V. includes switchboard and exciter. Presently boxed for export. Offered at an extremely low price.

1—15 KVA 3/60/220 V. Ideal air commr to 3 cyl. Hill Diesel engine with control panel.

Fully automatic Permutit softener unit, 1946, Cap. 7600 gals. bet. generations.

2—8' dia. x 20' long Autoclaves, 100#, quick opening single door.

WARNER J. SHERB, INC.
342 Madison Avenue, New York, N.Y.
Telephone MUrray Hill 2-9098

Immediate Delivery in All Types of

BOILERS

Bought • Sold • Rented

ERIE CITY ECONOMICS

125 Lbs.—150 H.P.—1933-1938
150 Lbs.—125 H.P.—1947
Fire Box Type—165 H.P.—125 Lbs.—1941
Package Type—10-15-50-60-100 H.P.
Heating Boilers—5000-8000-12000 Ft.
8000 Gal. Cement Lined Hot Water Heater
Oil Burner—150 G.P.H. #6 Oil, Rotary, Equal New.

BOILER & EQUIPMENT CO.
743 Bedford Ave. Brooklyn 5, N. Y.
ULster 5-3588

INTAKE SCREEN

1—Link-Belt Model #46 Vertical traveling "Clean Water" Intake Screen 16'-6" centers, trays 72" wide with front spray. Capacity for screening 12,000 gallons water per minute at velocity of 1.9' per second through 100% clean screen cloth with water in screen at low level of 4'-8".

This is a new screen. It has never been used. Available for immediate shipment. For complete details and price WRITE

P. H. GLATFELTER CO.
Spring Grove, Pa.

FOR SALE

2—Size 4 Riley Atrita Unit Pulverizer with separately driven coal feeders.

1—Hoppes Feedwater Heater, Class H, Size D Rated at 4000 boiler HP.

1—Cameron Boiler Feed Pump—4 stage, 500 gpm. 462 ft. head, 1750 RPM. All removed in plant expansion program. Spare parts included, priced to sell.

NEKOOSA-EDWARDS PAPER CO.
PORT EDWARDS, WISCONSIN

For Sale

3 AIR CIRCUIT BREAKERS

3 Westinghouse type DA50 air circuit breakers, 600 V AC, 3 pole, 1000 ampere. Good condition. Best offer over $2,600.00. Mr. R. Reinheimer, Stratos Division, Bay Shore, L.I., New York.

FAIRCHILD
ENGINE & AIRPLANE CORP.
Stratos Division Bay Shore, L.I., N.Y.

Nordberg-G.E. 875 KW diesel generator set, 257 rpm, 2300 v., 1250 HP, complete.
Allis C 625 KW turbo-generator set, cond., 440 v.
1500 KW McIntosh-Seymour-G.E. diesel elec. gen. set, a.c. 3-60-2300 v., 300 rpm.
Locomotive cranes, Orton 40-ton, Ind.-BH 30-ton.
Locomotives, 7 to 80 tons, diesel, gas, steam.
Diesel motor scrapers, 15-yd. (13).
Whirley portal gantry cranes, 35-50 tons.

H. Y. SMITH CO.
828 N. Broadway Milwaukee 2, Wis.

MOTOR GENERATORS

1—150 KW G.E. 4000/23000 v—250 v—1200 rpm
2—150 KW Westgh. 2200 v—275 v—900 rpm

AIR COMPRESSORS

1884 ft. CHICAGO PNEU. OCE 2300 V
676 ft. WORTHINGTON 3/60/220/440 V

DARIEN, 60 E. 42nd Street, New York, N. Y.

FOR SALE

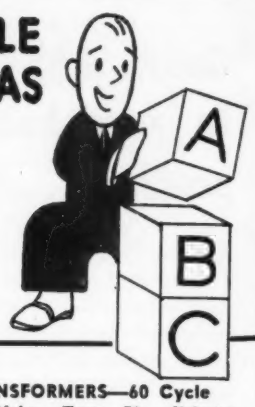
13x12 Skinner Simplex Uniflow Engine
105 lbs. Steam Pressure. 3-5 lbs. Back Pressure. 275 RPM. 75 HP. Weight 17,000 lbs. Fair Condition.

BLUM SHOE MFG. CO.
DANSVILLE, N. Y.

GENERATOR SET BARGAIN

187½ KVA alternating current generator, 3 phase, 60 cycle, 440 volt, with belted 15 KW, 125 volt exciter. Direct connected to a Skinner Universal Uniflow engine 150# steam pressure, 5# back pressure. Operating panel includes AC & DC volt meters, ammeters, rheostats, circuit breakers, GE voltage regulator. Piping, valves etc. Unit may be inspected in operation. A rare bargain. Write Mr. W. HILL, HILLWOOD MFG. CO., 21700 St. Clair Ave., Cleveland, Ohio.

SIMPLE AS



You get Guaranteed Electrical Equipment when you know its REBUILT & TESTED BY HEMPHILL ELECTRICAL ENGINEERS

JLHC — This seal says so!

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1500	G.E.	Pyranol	3	4150x2400
1	1000	G.E.	Auto	3	4150x2400
2	750	G.E.	HT	3	4150x120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G.E.	H	1	13200x220 440
2	300	G.E.	H	1	13200x440
1	200	G.E.	H	1	13200x440
3	200	G.E.	H	1	13200x440
2	200	A.C.	CBS	1	480x120/240
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	150	G.E.	H	1	2400x120/240
3	100	G.E.	H	3	13750x125/216Y
3	50	G.E.	H	1	4800x120/240
3	25	G.E.	H	1	575x115/230
3	25	Niag.	OISC	1	2400x480
1	25	G.E.	H	1	440x110/220

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4150SR
1	300	G.E.	1200	230	2400/4150SR
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC
1	20	E.M.	1800	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	181G	220

Qu.	H.P.	Make	Speed	Volts
1	150	A.C.	360	440
1	125	El. Mach.	900	4800
1	100	G.E.	900	2200

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
1	60	G.E.	1800	MT	220
1	60	G.E.	900	MT	440

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MPC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	860	RC
1	25	Whse.	825	SK

Member of The National Industrial Service Association, Inc.

FOR POWER
J.L. HEMPHILL & CO.
1604 53rd STREET NORTH BERGEN, N. J.
PHONE NEW YORK LONGACRE 5-3222
PHONE NEW JERSEY UNION 3-2010

2 B & W BOILERS

WATER TUBE — ASME CODE

From ATR Tug

Built 1943

15,000 lbs. steam/hr./unit—normal

18,000 lbs. steam/hr./unit—max.

Design Pressure—268 lbs./sq. in.

Temp., degree Fahrenheit

Total steam at drum outlet (saturated) 409

Forced draft—turbine driven blowers

Boiler heating surface . . . 1508 sq. ft.

Fuel . . . oil or gas

FOR DETAILED INFORMATION

WRITE — WIRE — PHONE

THE BOSTON METALS CO.

313 E. Baltimore Street

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Curtis 7-5050

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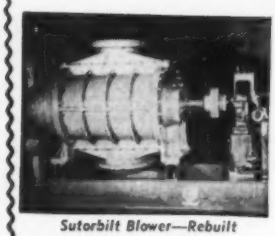

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3¼	W	Clarage
8	I	Bayley
7	B/C	Bayley
6	LL	Buffalo
85	5V	Sturtevant
5½	HS	American
4	LL	Buffalo
1⅝	W	Clarage
3½	AHS	American
4	M	Garden City

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225	96	Allen-Billmyre
3760	32	N. American
3860	24	Spencer
10400	20	Ingersoll Rand
1500	16	Spencer
1100	16	N. American
1075	16	Spencer
1000	16	Spencer
100	16	Gen. Blower

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63—10 KVA
61—7½ KVA
65—5 KVA
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13—1½ KVA

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1—400 A. 37 KV WEST. 0221
1—1200 A. 15 KV GE FHKO236
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1—600 A. 15 KV Condit O-1

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9—1200 A. 15 KV 500 MKVA West. CO-11
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26	1500	West.	525/600	600 RPM
32	1500	Al Ch.	525/600	675 RPM
4	1200	Al Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600	600/900 RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G. E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

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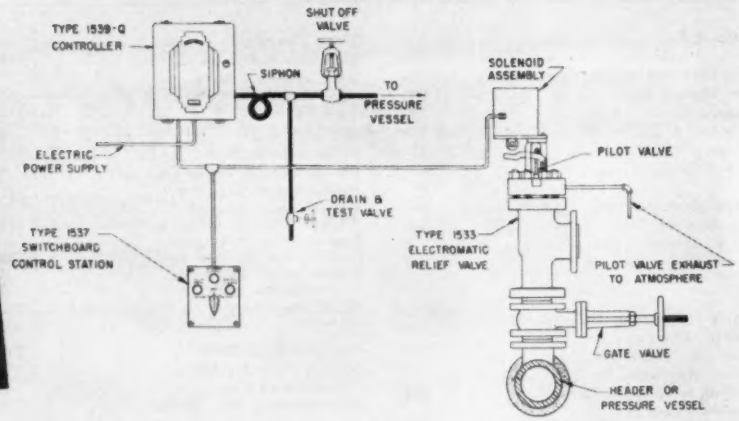
THIS IS THE CONSOLIDATED ELECTROMATIC RELIEF VALVE SYSTEM



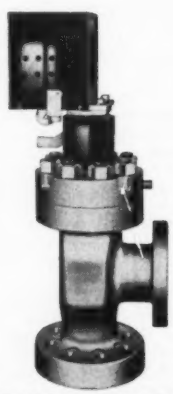
THIS IS WHAT IT GIVES YOU

1. More accurately balanced boiler operation at peak loads.
2. More uniform line pressure.
3. Power conservation.
4. Less maintenance of spring-loaded safety valves.
5. Greater protection against overheating your superheater.
6. Increased efficiency for your steam generating plant.

Automatic, electrically actuated, the Consolidated Electromatic Relief Valve can be set for a differential of 1% or less between opening and closing pressure; relieves pressure precisely within close limits. The valve is operated by a solenoid actuated by a pressure-sensitive element or switch. For automatic or manual service or to cut the valve out of service, just set the switch. Cyclic action is practically instantaneous. Valve operation is not affected by high superheat temperatures or other variables. Manual operation *at any pressure* assures positive circulation through the superheater and greater steam flows during start-up periods than the vent valves normally provide. Danger of burning superheater tubes is minimized under all conditions of service.

You can also use the Consolidated Electromatic as a superheater surge vent or to purge a superheater or header — reduce the possibility of damage to the seats of regular valves and turbine equipment.

Greater efficiency and economy is a "must" in the steam generating plant. That is why the Consolidated Electromatic Relief Valve is important to you. Get complete construction, installation and operating details. Write today for Bulletin 720.



CONSOLIDATED ELECTROMATIC RELIEF VALVE

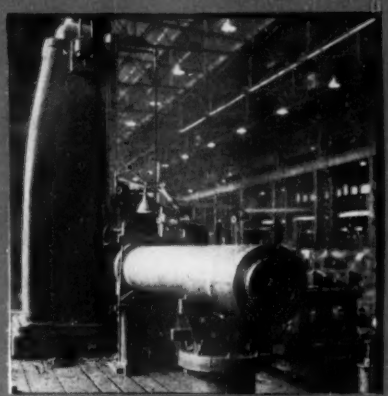
Sizes:
2½", 4", 10", 14"
Pressures:
Up to 2500 p.s.i.
Temperatures:
Up to 1100° F.
Standard Connections:
A.S.A. flanged and welded.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Part of the welding floor at Grinnell's Warren, Ohio Plant



Heavy wall pipe being machined to the proper welding bevel on a pipe mill

Welding (induction heating coils in place for preheat, welding heat and stress relieving.)

How shop fabrication of piping keeps

COSTS DOWN... QUALITY UP!

When you specify piping fabricated in Grinnell shops, you are ALL to the good.

Here's why: — Included in the price (which is determined in advance) are such items of expense as:

- Interpretive engineering
- Shop sketches and planning
- Procurement of materials
- Heat, light, power, water, compressed air, expendable tools and supplies

But Grinnell even goes further. Grinnell finances material inventories and payrolls for you; carries insurance; makes no charges for waste material or spoilage.

On the production side, too, you benefit. Piping fabricated in Grinnell shops is done under ideal conditions, with modern equipment, by personnel qualified for each class of work. It is rigidly inspected and tested to meet customer's specifications and all applicable codes. Before shipment, it is cleaned inside and outside and painted. It is squared to dimensional tolerances, so that sub-assemblies can be erected at the job site quickly and easily.

You can count on it . . . Grinnell shop fabricated piping *guarantees* maximum quality and economy.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Automatic Control

—of Mixed Bed Demineralization and Silica Removal by Ion Exchange Resins

• Permutit motor operated valves make regeneration of the Mixed Bed Demineralizer completely automatic. This gives more positive control . . . eliminates the dangers of costly human errors—and takes less time . . . saves man-hours formerly spent in regeneration. In a recent installation for a 1450 psi boiler, two compact Permutit Mixed Bed units fill all make-up requirements . . . supply demineralized, silica-free water continuously and automatically—even if one unit is out of service. What better way to eliminate boiler scale and silica deposits on turbine blades!

MINERAL IMPURITIES REACH VANISHING POINT

An almost infinite number of ion exchange steps take place simultaneously in the homogeneous mixture of anion and cation exchangers. Result—mineral content so low that conventional water analysis methods fail. Effluents of Permutit Mixed Bed units have contained *total* electrolytes as low as 0.01 ppm, and silica as low as 0.01 ppm. Under service conditions, values may be slightly higher. (Most distilled water contains 2 to 10 ppm electrolytes . . . costs much more to produce.)

TWO AMAZING RESINS DO THE JOB

Highly efficient Permutit Q and Permutit S do the whole job under positive automatic control in the Mixed Bed Demineralizer. Permutit Q is a high capacity hydrogen cation exchange resin that is extremely resistant to wide pH ranges, high temperatures, and oxidizing conditions. Permutit S, a strongly basic resin with a high reaction rate, reduces silica to a range far lower than previous methods.

New Booklet—DEMINERALIZATION BY ION EXCHANGE

This interesting new bulletin describes the key methods of demineralizing water and removing silica by ion exchange.

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PERMUTIT®

The only manufacturer of both ion exchangers and water conditioning equipment of all types.

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS